DISTRIBUTION-BASED SUPPLY SYSTEM: WILL IT PROVIDE MORE EFFECTIVE SUPPORT TO THE WARFIGHTER?

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MASTER OF MILITARY ART AND SCIENCE

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The study conducts a comparative analysis between the stockpile-based logistics system used in the Gulf War and the developing distribution-based logistics system which is the cornerstone of Joint Vision 2010's focused logistics. The primary research question answered is: Will a distribution-based supply system provide more effective supply support to the warfighter in a major theater of war scenario? Two subordinate research questions are: How lean, in terms of personnel, organizations, infrastructure, inventory, and budget can this distribution-based system be before it is ineffective? and What metrics will be used to determine the system's effectiveness? Transforming the supply system into a distribution-based supply system force requires major changes in doctrine, organization, and mindset such as inventories in the distribution-based supply system, small temporary inventories of fast-moving supply lines and intransit materiel. When a system does not have visibility of what it contains, efficient management is not possible. Thus, information or asset visibility is a key to efficient distribution. Knowing what is in the system and where it is allows operators to make timely decisions.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

DISTRIBUTION-BASED SUPPLY SYSTEM: WILL IT PROVIDE MORE EFFECTIVE SUPPORT TO THE WARFIGHTER? by MAJ Steven L. Wade, USA, 91 pages.

The study conducts a comparative analysis between the stockpile-based logistics system used in the Gulf War and the developing distribution-based logistics system which is the cornerstone of Joint Vision 2010's focused logistics.

The primary research question answered Is, Will a distribution-based supply system provide more effective supply support to the warfighter in a major theater of war scenario? Two subordinate research questions are, How lean, in terms of personnel, organizations, infrastructure, inventory, and budget, can this distribution-based system be before it is ineffective? and What metrics will be used to determine the system's effectiveness?

Transforming the supply system into a distribution-based supply system force requires major changes in doctrine, organization, and mindset such as the outmoded "push system" of supplying combat forces. There will still be inventories in the distribution-based supply system, small temporary inventories of fast-moving supply lines and intransit materiel.

When a system does not have visibility of what it contains, efficient management is not possible. Thus, information or asset visibility is a key to efficient distribution. Knowing what is in the system and where it is allows operators to make timely decisions.

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LIST OF ABBREVIATIONS

AC/RC	Active Component/Reserve Component
AFSCC	Air Forces Service Component Commander
APOD	Aerial Port of Debarkation
ASCC	Army Service Component Commander
ASL	Authorized Stockage List
ATAV	Army Total Asset Visibility
AUTODIN	Automatic Digital Network
BD	Battlefield Distribution
BRAC	Base Realignment and Closure
CAPS	Computerized Aerial Port System
CASCOM	Combined Arms Support Command
CINC	Commander in Chief
COMMZ	Communications Zone
CONUS	Continental United States
COTS	Commercial of the Shelf
CRP	Central Receiving Point
DA	Department of the Army
DAAS	Defense Automatic Addressing System
DDN	Defense Data Network
DMC	Distribution Management Center
DOD	Department Of Defense

DOS	Days of Supply
DS	Direct Support
DSU	Direct Support Unit
EAC	Echelon Above Corps
FAD	Force Activity Designator
FIFO	First-In-First-Out
GSU	General Support Unit
GTN	Global Transportation Network
ICP	Inventory Control Point
ILAP	Integrated Logistics Analysis Program
ISD	Installation Supply Division
ITV	In Transit Visibility
JIT	Just-In-Time
LCA	Logistics Control Activity
LIF	Logistics Intelligence File
MCSCC	Marine Corps Service Component Commander
MEF	Marine Expeditionary Force
MILSTAMP	Military Standard Transportation and Movement Procedures
MILSTEP	Military Supply and Transportation Evaluation Procedures
MILSTRAP	Military Standard Transaction and Accounting Procedures
MILSTRIP	Military Standard Requisitioning and Issue Procedures
MMC	Materiel Management Center

MTW	Major Theater of War
NICP	National Inventory Control Point
NSCC	Naval Service Component Commander
ODCSLOG	Office of the Deputy Chief of Staff for Logistics
OL	Operating Level
OST	Order-Ship-Time
OSTL	Order-Ship-Time Level
PD	Priority Designator
RDC	Research Development Center
RF-AIT	Radio Frequency-Automated Identification Technology
RML	Revolution in Military Logistics
RO	Requirement Objective
ROP	Reorder Point
RSO&I	Reception, Staging, Onward Movement, and Integration
SA	Situational Awareness
SAMS-1	Standard Army Maintenance System-1
SARSS-1	Standard Army Retail Supply System-1
SL	Safety Level
SPOD	Seaport of Debarkation
SSA	Supply Support Activity
TAACOM	Theater Army Area Command
TAV	Total Asset Visibility

TC-ACCIS	Transportation Coordinator's Automated Command and Control Information System
TC-AIMS	Transportation Coordinator's Automated Information for Movements System
TCMD	Transportation Control Movement Document
TELNET	Telecommunications Network
TOE	Table of Organization and Equipment
TOO	Time of Ownership
TRAPR	Transportation Resource Accounting and Phone Reporting System
TRASR	Transportation Resource Accounting and Satellite Reporting System
TSC	Theater Support Command
ULLS-S4	Unit Level Logistics System-S4
ULSS-G	Unit Level Logistics System-Ground
UMMIPS	Uniform Materiel Movement and Issue Priority System
UND	Urgency of Need Designator
VM	Velocity Management
WPS	Worldwide Port System

CHAPTER 1

INTRODUCTION

> You can have all the fancy weapon systems in the world, but if you are not capable of delivering ammo, fuel, and spare parts to those weapons systems they will be ineffective. Therefore, you must strike a proper balance between combat system modernization and logistical system modernization.[1]
>
> H. Norman Schwarzkopf, " The Truck Stops Here"

The end of the Cold War had a dramatic impact on international security relationships and political framework around the world. The breakup of the former Soviet Union released a host of threats and challenges across the former republics and client states. Ethnic conflict, tribal warfare, and outlaw states threaten regional stability throughout the world. Today, US military forces are called upon to respond to transnational threats such as terrorism, drug trafficking, and international organized crime.[2] These changing relationships and threats led to fundamental changes in the US *National Security Strategy,* [3] as well as in the supporting US *National Military Strategy.*[4]

The 1998 *National Security Strategy* still emphasizes deterrence as an initial response to a potential adversary. Deterrence during crises involves the demonstration of US resolve to a particular country or region. Enhancement of US warfighting capability in the theater may cause forces in or near the theater to move rapidly closer to the crisis area.[5] These rapid responses to trouble spots along with smaller-scale contingencies operations are the most likely challenges to US military forces and require a fundamental change to the *National Military Strategy.*

The *National Military Strategy* is built upon four strategic concepts, which are strategic agility, overseas presence, power projection, and decisive force. Strategic agility is the timely concentration, employment, and sustainment of US military power anywhere at the US's initiative. Overseas presence is the visible posture of US forces and infrastructure strategically positioned forward, in, and near key regions. Power projection is the ability to rapidly and effectively deploy and sustain US military power in and from multiple dispersed locations until conflict resolution. Finally, decisive force is the commitment of sufficient military power to overwhelm an adversary, establish new military conditions, and achieve a political resolution to US national interests.[6] A viable national military strategy requires a responsive and reliable supply system. The linchpin of that military strategy is the ability to project and sustain decisive force anywhere in the world with little or no warning.

The emphasis on this rapid power projection has brought enormous challenges to Army logisticians and radically altered how operations have been conducted for the last one hundred years. Historically the US has typically been able to project its combat power at the strategic and operational levels of war over time. The natural resources of the US along with an advanced mass production system favored vast production of war materiel to follow any forces projected into battle. The geographic location of the US, in the Western Hemisphere, isolates it from much of the rest of the world. This isolation created long lines of communications and forced the Army to commit stockpiles of supplies at intermediate bases that strategically supported these forward forces. This creation of a mass logistics system with multiple stockpiles at echelons throughout the theater was the solution to the long lines of communication dilemma and enabled the US to support its forward-deployed troops with enough sustainment stocks until surge replenishment took effect. The method of stockpiling supplies successfully supported World War II, Korea, Vietnam, the Cold War, and Desert Storm. Stockpiles, by their nature nevertheless, are labor intensive, slow to respond to changing situations, and expensive to obtain and maintain. These stockpiles, however slow and cumbersome, were the hedge against uncertainty in the supply chain, lessening the risk that forward forces would not have required stocks when needed. The drawdown of forces has reduced the requirement for these large stockpiles with many defense experts arguing for the elimination of stockpiles and inventory altogether just as in certain civilian industries (table 1). Reduction of inventory and the high cost associated with maintaining that inventory is a top priority for the Department of Defense (DOD) in this era of dwindling defense dollars. The DOD and Congress believe that the benefits of reducing and replacing the current inventory with a leaner one coupled with better business practices outweigh the risk of maintaining the safety stockages capable of sustaining the Army for global engagement.

DOD now shows an increasing willingness to accept greater risk in their supply chain based primarily on the belief that improved information and distribution technologies with revamped business processes will mitigate most if not all of the associated risks. This study examines those effects of a reduced inventory and its associated safety level, elimination of stockpiles, minimization of the logistical footprint, implementation of new business processes, and exploitation of current and emerging technologies, in providing supply support to maneuver forces.

TABLE 1

DOD INVENTORY REDUCTION

Metrics

Comparison of value of total DOD secondary item inventories against annual reduction goal.

- Measurement Method: $XX.X billion as of September 30 of FY XXXX.
- Target:
  - Sep 1996 - $67 billion (baseline)[1]
  - Sep 1997 - $64 billion
  - Sep 1998 - $61 billion
  - Sep 1999- $59 billion
  - Sep 2000 - $56 billion
  - Sep 2003 - $48 billion

Source: [1]Dr. J. S. Gansler, *Defense Logistics Strategic Plan* (Washington: US Government Printing Office, 1998), 25.

Background of the Study

This study examines the genesis of a distribution-based supply system, which was created in response to the post Cold War strategic environment. The study will conduct a comparative analysis between the stockpile-based logistics system used in the Gulf War and the developing distribution-based logistics system which is the cornerstone of *Joint Vision 2010*'s[7] Focused Logistics.

The challenge for current and future Army logisticians is to apply a focused logistics concept to the new military strategy. Focused logistics is the means by which logisticians deliver the proper mix of forces and materiel to the area wherever and whenever needed. *Army Vision 2010* describes a single logistics system across the military continuum of operations from the tactical through the operational, to the strategic levels of war to accomplish focused logistics. This single logistics system fuses logistics information and transportation technologies to provide rapid response and sustainment on the modern battlefield.[8] The distribution-based supply system, which is the melding of supply and transportation processes, is the technique by which focused logistics is accomplished.

Research Question

The primary research question is, Will a distribution-based supply system provide more effective supply support to the warfighter in a major theater of war (MTW) scenario? Two subordinate research questions are, How lean, in terms of personnel, organizations, infrastructure, inventory, and budget, can this distribution-based system be before it is ineffective? and What metrics will be used to determine the system's effectiveness? This thesis uses US Army Field Manual 100-10-1, *Theater Distribution*, the emerging capstone doctrine for distribution in a theater of operations and the Battlefield Distribution concept as the distributions based supply system's doctrinal start point. Several of the most current Army logistical doctrine and concepts were explored in this study such as the Theater Support Command, Distribution Management Center, Reception Staging, Onward Movement, and Integration and Velocity Management.

Joint Publication 4.0, *Doctrine for Logistics Support of Joint Operations*, states that " for a given area and for a given mission, a single command authority should be responsible for logistics."[9] The Theater Support Command (TSC) is that authority. The TSC is the Commander in Chief's (CINC's) logistics operator in the theater. The TSC is an organizational redesign of the Theater Army Area Command (TAACOM) which provided continuous echelon above corps (EAC) command and control of support operations throughout the communications zone (COMMZ). The TSC is a multifunctional organization that centralizes the command and control and support functions at EAC. While the TSC replaces the TAACOM, it has generated a need for a distribution management center (DMC) in the Support Operations Branch of the TSC.[10] Figure 1 depicts command relationships of the TSC with the CINC, Army Service Component Commander (ASCC), Army supporting elements, and supporting elements of the other services.

The DMC of the TSC monitors the theater distribution network and pipeline by accessing total and intransit asset visibility systems. DMCs track shipments and establish priorities to ensure transportation resources are properly aligned with the material movement.

US Army Field Manual 100-17-3, *Reception, Staging, Onward Movement, and Integration* (RSO&I) is the doctrinal process in which forces are rapidly distributed to the CINC's contingency plan. RSO&I ensures priority timeline deployment of CSS operators and critical logistics functions required to support the rapid throughput of combat power which is the heart of force projection.

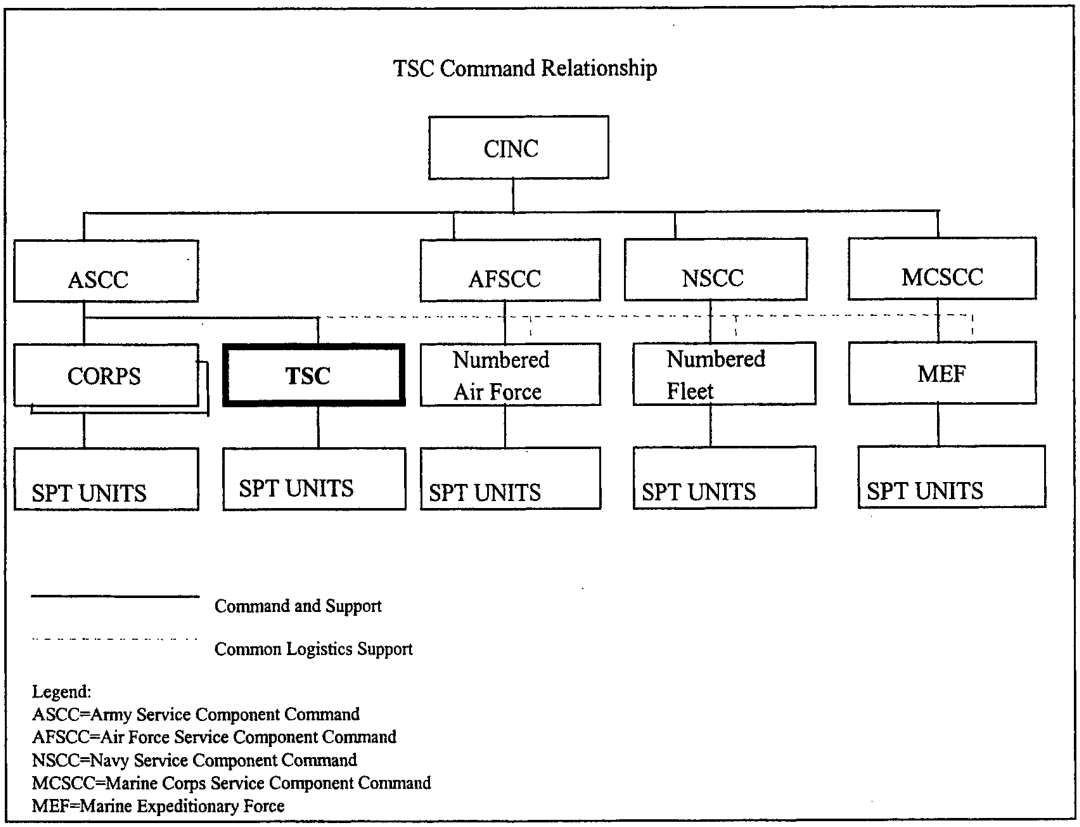

Figure 1. Illustration from US Army Combined Arms Support Command, Special Text, *Theater Support Command*, (Fort Lee: US Army Combined Arms Support Command: 1997), 5.

Velocity Management (VM) is the approach for improving responsiveness and efficiency of Army logistics processes. VM substitutes velocity and accuracy for mass in the logistics system by reducing cycle time of logistics processes, thereby increasing responsiveness to the user and permitting the reduction of safety stockage.

The thesis explains the composition of a distribution-based supply system that provides reliable, flexible, cost effective, and prompt logistics support to the warfighters while achieving a lean infrastructure and a minimized logistical footprint. The study researches the influence that situational awareness (SA) has on distribution responsiveness as well as the effects of evolving organizational structure for the support of Force XXI. Force XXI is the transformed industrial age army of the Cold War into an information age military force primarily based in the continental US and able to rapidly project itself to any crisis in the world. It is the development of that Army which will exist in 2010. Force XXI will use information operations and situational awareness to achieve victory on the modern battlefield. The research also examines principles of military distribution such as centralized management with decentralized execution, infrastructure optimization, throughput maximization that bypasses echelons of support, minimization of forward stockpiles, and the maintenance of a continuous seamless logistical pipeline flow.

Background of the Distribution Supply System

Previous Army logistical doctrine, developed to support a general conflict with the Soviet Union in Europe, was shown to be inadequate after Operations Desert Shield and Storm. The most challenging problem of that conflict for logisticians was overly congested ports of embarkation and debarkation. The Army lost visibility of unit equipment and sustainment stocks just as it did nearly one hundred years earlier in the Spanish-American War of 1898. Critically needed supplies were delayed due to improper or missing documentation. Units began flooding the strategic supply system with requisitions for items already in theater. The strategic supply system responded by sending more supplies with or without documentation compounding an already unmanageable quagmire. Users of the system lost confidence in the process when it was unresponsive to their needs.

The flaws in the supply system led Major General Thomas W. Robinson, Commander of the US Army Combined Arms Support Command (CASCOM) to originate the battlefield distribution (BD) concept in August 1994.[11] A Headquarters, Department of the Army, Deputy Chief of Staff for Logistics' sponsored RAND Corporation report, a DOD sponsored civilian think tank, joined the BD concept and called for improvements in the current logistics processes, that is, VM. The BD concept concentrated on the root cause of the supply problem, which was visibility of assets. The problem in Desert Shield and Storm was not a lack of supplies but the visibility of stocks and equipment on hand. The Army's depots aggressively processed Desert Shield and Storm requisitions but in their haste neglected to properly document what was in the containers and who was to receive the contents. There was also unit equipment shipped to the theater in similar containers without documentation, which aggravated the situation. The fundamental tenet of the new distribution doctrine is total asset visibility during end to end supply pipeline movement to remedy the documentation problem of both sustainment stocks and unit equipment. CASCOM's Battle Laboratory began to explore commercial off the shelf technologies (COTS) primarily radio frequency-automated identification technology (RF-AIT) to accomplish total asset visibility. Total asset visibility would also restore end user confidence in the supply system by providing visibility of major end items down to unit level and secondary items down to the direct support (DS) level authorized stockage list (ASL). Distribution managers will have information access across all classes of supply from the tactical through the strategic level of logistics.

The RF-AIT systems track supplies and equipment from the depot or home station to the port of embarkation, into the theater, and ultimately to the supported or requesting organization. At each transition node along the way passive interrogators chart the movement of materiel and relay this information into logistical and command channels as appropriate. The VM initiative, during the same time period, was refining logistics processes in the domains of transportation, procurement, weapon system design and development, component repair, and order-ship-time (OST).

BD explored new technologies but also introduced a "hub and spoke" distribution process. Bulk cargo enters the distribution terminal (Hub) and is sorted for redistribution through the spokes of the distribution system.[12] The primary difference between a hub and a warehouse relates to the difference in the reasons for their existence. A hub's primary purpose is to move supplies and equipment to users. A warehouse, on the other hand, exists to store supplies and equipment first, and secondarily, to ship them to users. The hub emphasizes flow while a warehouse emphasizes storage. Hubs are focused on movement and direct unit shipments are possible, bypassing the hub with passive identification interrogation conducted while enroute. The BD concept with RF-AIT was used successfully by Major General James Wright, Commander, 21st TAACOM, during his units' support of Operation Joint Endeavor in Bosnia.

The evolution and maturation of the BD and VM concepts has been the subject of numerous white papers, professional journal articles, and Rock Drills. Rock Drills are senior-level training events which lay out an entire process from top to bottom. These training events involve multimedia presentations simulating logistical process with soldiers demonstrating particular procedures of those processes. This visualization allows the senior leaders to view the process holistically and examine the pieces individually. To date several RSO&I and Power Projection Rock Drills have been conducted at Fort Eustis, Virginia. CASCOM presented a series of Distribution Rock Drills at Fort Lee, Virginia, beginning in December 1997, culminating in the Chief of Staff of the Army Rock Drill on 28 May 1998.[13] These forums highlighted progress and the direction that distribution-based logistics was headed with a look at all enablers, force structure, and doctrine required for the system to be both effective and efficient.

Assumptions

This thesis assumes that force projection will continue to be a strategic concept of US *National Military Strategy* and short notice deployments and responses to smaller scale contingencies will continue to increase in frequency. There will be continued political pressure to reduce the military inventory of supplies with strategic, wholesale, and retail stocks drawing down coupled with reductions in logistical forces and infrastructure. The study assumes that the force closure timetable for a major theater war will remain at seventy-five days. The trend toward privatization and or outsourcing, contracting civilian corporations to perform task previously performed by Department of the Army (DA) personnel, civilian or military, to accomplish base support and operational logistical processes will continue. The study further assumes that funding for improvements in the distribution system will continue. Finally the study assumes that while technology will continue to advance rapidly, America will maintain the technological edge and possess military information superiority.

Definitions

Anticipatory and Predictive Logistics. The use of shared operational and logistical information to anticipate and or predict unforeseen requirements or shortfalls and act upon these situations rather than react to them.[14]

Battlespace Logistics. A seamless continuum of support that extends from the strategic level, through the operational level to the tactical level warfighter.[15]

Digitization. The Army's effort toward the achievement of a seamless and holistic information architecture.[16]

Distribution. The operational art that encompasses all other logistics disciplines, synchronizing their actions to generate focused logistics support. It provides the right CSS resources at the right time and place on the battlefield.[17]

Distribution System. That complex of facilities, installations, methods, and procedures designed to receive, store, maintain, distribute, and control the flow of military materiel between the point of receipt into the military system and the point of issue to using activities and units.[18]

Focused Logistics. The fusion of information, logistics, and transportation technologies to provide rapid crisis response, to track and shift assets even while enroute, and to deliver tailored logistics packages and sustainment directly at the strategic, operational, and tactical level of operations.[19]

Knowledge Based. Information that consists of facts, judgmental information and procedural information. The capability to extend available information based on rules or experience.[20]

Maximized Throughput of Units and Sustainment. The bypass of support nodes which produces reductions in handling and increases velocity.[21]

Minimized Logistical Footprint. Modular and or tailored units and reduced stockpiles at every echelon to minimize the logistical force structure in a theater of operations. This is not the elimination of critical functions that must be performed but moving these functions whenever possible out of theater to free up strategic lift to accelerate the arrival of combat forces.[22]

Operational Logistics. Ties tactical requirements to strategic capabilities in order to accomplish operational plans. It encompasses support required to sustain joint and or combined campaigns and other military activities within an area of responsibility. Military units, augmented by DOD civilians, civilian contractors and host nation resources, constitute the organizational structure of elements found at this level. The primary focus of the operational logistician is on reception, discharge, onward movement of forces, positioning of facilities, materiel management, theater level maintenance, movement control, distribution, reconstitution, and redeployment.[23]

Strategic Logistics. Includes the Nation's organic industrial base and DOD's link to its military forces. This level is primarily the purview of DOD, individual services, and non-DOD governmental agencies, with support from the private sector. The strategic logistician's focus is on requirement determination, personnel and materiel acquisition, prepositioning, stockpiling, strategic mobility, deployment, redeployment, and demobilization. Based upon current DOD infrastructure reduction goals, this level could experience continued corporate consolidation as logistics automated systems are already migrating to DOD standard platforms, language, and data.[24]

Tactical Logistics. The synchronization of all logistics activities required to sustain soldiers and their systems. Military units, organic to the deployed tactical force, constitute the bulk of the logistics organizations at this level. However, the organization may include civilian contractor personnel and DOD personnel. The focus of the tactical logistician is on the primary logistics warfighting support functions of manning, arming, fueling, fixing, moving, and sustaining the soldier and his equipment.[25]

Theater Distribution. A system designated to maximize the throughput of people, supplies, and equipment to support the maneuver commander.[26]

Time Definite Delivery. Stabilized order-ship-time, delivery consistency, and a metric to evaluate this new distribution-based logistics system.[27]

Limitations

The study will compare the stockpile-based supply system with the distribution-based supply system in a generic environment. Although no two theaters are the same and will present unique challenges for comparison this study will only provide information on supply movement across the Army regardless of the spectrum of conflict. The study will examine distribution operations, requisite types of force structure, skills, and enablers focused on performing Army distribution in a theater of operation. The Army is responsible for the majority of inland supply distribution in theater of operation which the research will focus on. The distribution processes is an inherently joint undertaking and it would be impossible to perform distribution-based logistics without Air Force and Navy participation. This thesis will address those relationships but will not examine them in depth which is outside of the scope of this research study.

Delimitations

This thesis will not examine in detail the effect of the required changes to organizational structure that must occur to transform this stockpile-based logistics system into a distribution-based system. The study will indicate certain types of organization required to optimize distribution throughput but will not delve into the force structure development process. The thesis will explore technological and doctrinal enablers need to construct a distribution system but will not determine the numbers of enablers required at each echelon to assure that the distribution system achieves optimization, that is, maximum throughput of personnel and materiel.

Significance of the Study

This thesis, by use of its research design methodology, will explore the need to change from a stockpile-based supply system to a distribution-based logistics system while preparing the system to become knowledge based where the system is constantly seeking better means to satisfy new and emerging requirements. It will verify the need to change and possibly adopt current commercial business along with metrics to measure the effectiveness of the distribution base supply system. The thesis will identify interoperability requirements amongst the current systems, supply, information, transportation and depots, to maximize efficiencies while incorporating sound business practices. Finally, the study will examine how lean the inventory and infrastructure can become before it is ineffective.

Conclusion And Transitions

Chapter 1 introduces the thesis by describing the background of the research question, background of both the stockpile-based supply system and the distribution-based supply system, operational definitions, the significance of the study and the potential contributions to the field of military logistics. The next chapter continues the investigation of recent research and existing literature on the subject of distribution.

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[1]H. Norman Schwarzkopf, "The Truck Stops Here," (Army Times. October 1997), 12.

[2]William J. Clinton, *A National Security Strategy for a New Century* (Washington: US Government Printing Office, 1998), 15.

[3]Ibid.

[4]John M. Shalikashvili, *National Military Strategy of the United States of America-Shape, Respond, Prepare Now: A Military Strategy for a New Era* (Washington: US Government Printing Office, 1997), 1.

[5]Clinton, 15.

[6]Shalikashvili, 3-4.

[7]Joint Chiefs of Staff, *Joint Vision 2010* (Washington: US Government Printing Office, 1997), 24.

[8]US Army, *Army Vision 2010* (Washington: US Government Printing Office, n.d.), 8.

[9]Joint Chiefs of Staff, Joint Publication 4.0, *Doctrine for Logistics Support of Joint Operations* (Washington: US Government Printing Office, 1996), v-3.

[10]US Army, Combined Arms Support Command, Special Text, *Theater Support Command* (Fort Lee: US Government Printing Office, 1997), 2-2.

[11]MAJ George G. Akin, "Battlefield Distribution: The Velocity Management Approach," *Army Logistician*, January-February 1996, 6-7.

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[13]US Army, Combined Arms Support Command, "Distribution Rock Drill" (briefing presented at the Chief of Staff of the Army Distribution Rock Drill, Fort Lee, Virginia, 28 May 19998), Distribution Laboratory, Fort Lee.

[14]Ibid.

[15]Logistics Integration Agency, *Army Strategic Logistics Plan Battlespace Logistics: The Vision* (Alexandria: Logistics Integration Agency, n.d.), 6.

[16]Dr. J. S. Gansler, *Defense Logistics Strategic Plan* (Washington: US Government Peinting Office, 1998), Appendix H.

[17]US Army, Combined Arms Support Command, "FM 100-10-1, Theater Support Command," (Briefing, Fort Lee: USACASCOM, 1997).

[18]Army Logistics Management College, Text ALM-48-5240-LC(G), *Physical Distribution Management Overview* (Fort Lee: US Government Printing Office, 1993), 1-1.

[19]Joint Chiefs of Staff, *Joint Vision 2010* (Washington: US Government Printing Office, 1997), 24-25.

[20]Gansler, Appendix H.

[21]US Army, Combined Arms Support Command, "Distribution Rock Drill" (briefing presented at the Chief of Staff of the Army Distribution Rock Drill, Fort Lee, Virginia, 28 May 19998), Distribution Laboratory, Fort Lee.

[22]Ibid.

[23]Office of the Deputy Chief of Staff for Logistics, *Army Strategic Logistics Plan* (Washington: US Government Printing Office, 1995), 2-5.

[24]Ibid.

[25]Ibid.

[26]US Army, Combined Arms Support Command, "FM 100-10-1, Theater Support Command," (Briefing, Fort Lee: US Government Printing Office, 1997).

[27]US Army, Combined Arms Support Command, Chief of Staff of the Army "Distribution Rock Drill Briefing," (Fort Lee: US Government Printing Office, 1998).

CHAPTER 2

REVIEW OF LITERATURE

This survey of literature begins with a search of historical sources of information on the subject of military distribution. The search then precedes to current sources and moves to secondary sources of information dealing with logistics, transportation, and information management all of which influences the distribution topic.

The principal source of information used for the study includes official military documents from military libraries, military publications, books, research papers, professional military and civilian industry journals, and US government publications.

Government Publications

Current and emerging doctrinal publications are very important in determining what environmental pressures are present which affect the methods of conducting distribution operations, force projection, and RSO&I operations. US government security and military literature place particular emphasis on force projection and global presence. The *National Security Strategy* asserts "effective and efficient global power projection . . . provides our national leaders with more options in responding to potential crises and conflict. Being able to project power allows us to shape, deter, and respond."[1] The *National Military Strategy* declares, " Power projection is the ability to rapidly and effectively deploy and sustain US Forces in and from multiple dispersed locations. Complementing overseas presence, power projection strives for unconstrained global reach."[2] FM 100-10, *Combat Service Support*, states that a force's strategic agility depends on deployment capability. Deployment begins at selected CONUS locations and continues from forts to ports of embarkation including strategic movement and ends with RSO&I of forces in a theater of operations.[3] Training and Doctrine Command (TRADOC) Pamphlet 525-5, *Force XXI Operations*, describes " A force-projection Army will devote much energy toward the synergy to be gained from actual rapid movement of lethal and survivable early entry forces increasing the ability to lift these forces by increasing strategic lift capability, through investment in sealift, airlift, and prepositioning."[4] US Army Field Manual (FM) 100-7, *Decisive Force* and FM 100-5, *Operations*, devote entire chapters to force projection considerations, operations, and stages.

Logistics Books

The central theme of modern logistics books dealing with the Gulf War was the tremendous scope of the logistical operations before, during, and after the war. In *War and Anti-War*, Alvin and Heidi Toffler describe that "Even the process of withdrawing US Forces after the fighting was a monumental task . . . over 40,000 containers were moved." [5] *The Whirlwind War* authors stated that "As XVIII Corps reported on the third day of its deployment, 'the combination of moving combat forces as rapidly as possible as well as essential service support from the Corps has generated requirements which exceeded limited resources immediately available to the Corps'." [6] *Into the Storm* author Tom Clancy describing the arrival of VII Corps from Germany states that "the planners had estimated they would have a steady state of 8,000 to 10,000 troops in port at any time with a stay no longer than two to three days. They ended up with triple those numbers. Between 5 December and 18 February 50,000 vehicles were off loaded and staged. Thirty-five hundred containers with spare parts and other critical items were sent forward." [7]

These three books outline the enormous undertaking and difficulties associated with supporting a major theater of war (MTW), such as Operations Desert Shield and Storm. The books cover predeployment, deployment, and sustainment of the Gulf War. Lieutenant General Joseph Heiser's book, *A Soldier Supporting Soldiers,*[8] chronicles his career in supporting three wars from World War II to Korea and Vietnam. General Heiser outlines common difficulties logisticians faced supporting those conflicts as well as future conflicts, emphasizing the need for asset visibility to relieve port congestion due to improper or missing documentation. The remainder of the logistical books focused on various complexities that are inherent in all supply chain operations.

Periodicals

The literature review examined several leading civilian industry periodicals to discover innovative techniques that business is using to optimize their distribution operations. The industry periodicals' theme was the relation of time to distribution productivity in conjunction with increased information availability. The literature noted that while on-time delivery was essential to an effective supply chain operation, consistency of deliveries was more important than merely going faster. Squeezing time out of the supply chain did not necessarily mean using the fastest mode but rather squeezing time out of operational processes. These publications not only explored procedures that increased speed of physical distribution but also various business practices and or processes that squeezed time out of all the companies' procedures in all departments. Asset visibility was another critical factor in optimizing supply operations. Knowing when and where material was in the supply chain allows for more timely and accurate inventory decisions. Horizontal and vertical visibility into an organizations supply chain was deemed critical in several industry periodicals.

In *IIE Solutions*, author Sumantra Sengupta discussed intelligent decision making and planning capabilities required for users of supply chains. He identified several primary drivers needed to improve the supply chain including:

1. Well-defined process with well-defined guidelines for decision making;
2. Removal of organizational behaviors and functional barriers;
3. Early visibility to changes in demand all along the supply chain;
4. A single set of plans that drives the supply chain operations and integrates information across the supply chain.[9]

The last driver necessitates the integration of data across the enterprise so the entire enterprise has common information on which to make plans or decisions.

The *Logistics Management and Distribution Report* and *Distribution-The Transportation and Business Logistics Magazine* showcased leading industry leaders' solutions to distribution dilemmas using information management linking all components of a corporation's supply chain. *Harvard Business Review* profiled articles on the use of information to speed process execution. *The Transportation Journal* explored the role of a transportation system in a successful just-in-time logistical operation. The *Army Logistician* published three articles directly related to the study. In the first article in the January-February 1994 issue titled "Supply Distribution Technology Tested," Suzanne J.

Poorker described a joint Army and Defense Logistics Agency (DLA) effort to improve the Army's supply distribution project with DLA's automated manifest system.[10] The January-February 1996 issue article, titled "Battlefield Distribution" by Major George G. Akin, explores the links between Velocity Management and Battlefield Distribution concepts. The article highlights the fact that velocity management is an integral part of battlefield distribution and transforms processes as it accommodates complexities along the logistics pipeline.[11] In the third article, published in January-February 1997, titled "Is Battlefield Distribution the Answer?" Captain Timothy W. Abel postulates that the distribution concept would be enhanced by reducing redundancy in class IX stockage points, personnel and equipment by consolidating the division's ground authorized stockage list from the three forward support battalions into the main support battalion.[12]

Conclusion and Transition

The review of literature in the distribution field offers an abundant supply of information. Industry and government organizations alike are using various forms of supply chain management to gain visibility of materiel flow through the manufacturing and distribution process. The recurring points were improving service to customers, reducing costs, and optimizing supply chain operations by improving information systems to give the organization global asset visibility. Numerous articles expressed the need for integration of the supply chain function throughout the organizational structure. Optimization of the supply chains was the goal of all the organizations. Furthermore, the field is constantly evolving as more and more industries and government organizations reengineer and reinvent themselves and strive to utilize the correct software solution to maximize productivity. The next chapter describes and defines the research methodology.

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[1]William J. Clinton, *A National Security Strategy for a New Century* (Washington: US Government Printing Office, 1998), 26-27.

[2]John M. Shalikashvili, *National Military Strategy of the United States of America Shape, Respond, Prepare Now: A Military Strategy for a New Era* (Washington: US Government Printing Office, 1997),20.

[3]US Army, Field Manual 100-10, *Combat Service Support* (Washington: US Government Printing Office, 1995), 1-9-1-10.

[4]Army Training and Doctrine Command, Pamphlet 525-5, *Force XXI Operations* (Washington: Government Printing Office, 1994), 3-2.

[5]Alvin and Heidi Toffler, *War and Anti-War* (Boston: Little, Brown and Company, 1993), 78.

[6]Frank N. Schubert and Theresa L. Kraus, *The Whirlwind War* (Washington: Center of Military History, 1995), 55.

[7]Tom Clancy, *Into the Storm* (New York: Prentice Hall, 1992), 204.

[8]Joseph M. Heiser Jr., *A Soldier Supporting Soldiers* (Washington: Center of Military History, United States Army, 1991).

[9]Sumantra Sengupta, "Seamless Optimization," *IIE Solutions*, October 1996, 29.

[10]Suzanne J. Poorker, "Supply Distribution Technology Tested," *Army Logistician*, January-February 1994, 38.

[11]George G. Akin, "Battlefield Distribution: Velocity Management Approach," *Army Logistician*, January-February 1996, 6-7.

[12]Timothy W. Abel, "Is Battlefield Distribution the Answer?" *Army Logistician*, January-February 1997, 30-31.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

This chapter defines the methodology for the conduct of the study, organization of the data, data collection, and analysis used in the thesis. The research questions will be examined by conducting a comparative analysis of the supply system in place prior to and during the Gulf War and the distribution-based supply system which is evolving to replace it. The thesis is designed to determine if the change from a stockpile-based supply system to a distribution-based supply system would generate more effective and efficient support to the warfighter in a force projection scenario to a MTW. The thesis also examines how lean, in terms of personnel, organizations, infrastructure, inventory, and budget, this structure should become before it is ineffective and what metrics are required to determine effectiveness.

Methodology

The basic method used for this study was a comparative analysis. The two supply systems, stockpile-based and distribution-based, were studied in order to determine their likeness and differences and their utility in the new strategic environment. The study begins with a brief retrospective look at the development of the stockpile-based system used in the Army from 1946 until Desert Shield and Desert Storm. This look examines the political environment and technologies that shaped the supply system with particular attention on the, advantages, disadvantages, and limitations of the system. Data for this portion of the methodology was collected from numerous logistical history texts, lessons learned, military case studies, and DOD publications. The first step was a study of the components of the stockpile-based supply system and an examination of the types of items held in the inventory. The next step describes the two supply levels, wholesale and retail, with a detailed accounting of the wholesale level. The wholesale requirements determination process is discussed with an explanation of the various factors that decide a procurement action. The next step was a brief description of the retail supply system and how supplies flowed in the stockpile-based supply system with an examination of the asset visibility capability of the system and the logistics response time.

The genesis of the distribution-based supply system was introduced with an overview of the first attempts at a system-wide improvement of the supply system. Next the methodology explores the requirement to revise the supply system based on observations of Operations Desert Shield and Storm and changes in the current strategic environment, military doctrine, emergent technologies, and the transformation from a forward deployed Army to a force projection Army. The research analyzes the *National Security Strategy* and *National Military Strategy* to determine the new strategic environment that is forcing the supply system to transform itself. Current and emerging doctrine was evaluated for its impact on the supply system. Technologies that were critical for the operation and maintenance of the distribution supply system were examined. The effects of changing the military from a forward-deployed force to a force projection force, primarily continental United States (CONUS) based, were evaluated for their effects on the supply system.

The research describes and analyzes the technologies utilized for asset visibility and the methods of their employment along with organizational interfaces required in maintaining that visibility and the logistics response time.

Both supply systems were laid out end to end, from the strategic CONUS base to the tactical level of logistics, with analysis of critical individual segments. The study examines two critical elements of a supply chain, asset visibility and logistics response time, as the benchmark tools to conduct the comparison. The comparison looks at past metrics to determine success of the stockpile-based system and the introduction of new metrics for a distribution-based system.

Finally in this stage, other factors such as the military drawdown, interest in the peace dividend, budgetary influences and others were examined to see what influence they had individually or collectively on the development of a new supply system.

Tables and charts were constructed which illustrates various challenges to both systems and displays criteria for success of both systems. Finally, in this stage, the overall systems are compared against the Focused Logistics tenet of the *National Military Strategy* to determine which system is more effective.

Conclusion And Transitions

Chapter 3 provided the methodology for the analysis of the research question. Chapter 3 also articulates the processes for assembling the information, arranging the data, and comparison of the systems which is the basis of the study.

The foundation of Chapter 4 organizes and presents the data to develop a comparative analysis between the stockpile-based and the distribution-based supply system with recommendations. Chapter 5 then will include a summary and conclusion with lessons learned and recommendations for future operations, technologies, and doctrine. The evidence of this study may assist in determining requirements for future changes in the distribution supply system, new and improved metrics to measure the effectiveness of that system, or a radical new supply system with greater efficiency as well as additional topics which may require further analysis.

CHAPTER 4

ANALYSIS

> It would be foolish for us logisticians to base our structure and our procedures on anything like 100 percent of resupply could be throughput from point of production to point of use. We've got to have control points along the way, especially where interferences are likely to occur, so that when they do occur, those at the control points know in advance what the alternative courses of action should be. But we should have the logistics general support capability to allow for the necessary flexibility. [1]
>
> LTG(R) Joseph M. Heiser, Jr., *A Soldier Supporting Soldiers*

Historical Background

The traditional American approach to achieving battlefield lethality has been through the mass of weapons' effects, personnel, and supply. [2] The American experience of waging war is steeped in the tradition of mass logistics. The genesis of the mass based stockage supply system used during the Desert Shield and Storm came from the US Army's experiences in World War II. The end of combat operations in 1945, at first, signaled to America that the current major problems of the world were solved and it was time once again for a rapid demobilization following four long years of war. US leaders however, felt otherwise and believed that the country was not in a position to behave as it had in the past following large mobilizations. America was a superpower with worldwide responsibilities and required an Army capable of meeting global requirements. Just as the Army began to assess their surplus property and the end of the lend-lease program, which distributed American war materiel to her allies during the war, the Soviet Union began to show signs that it wanted to expand their sphere of influence in Europe. The Communists moved swiftly to consolidate control in the countries they had captured and soon the US was called on to relieve Great Britain's assistance to Greece and Turkey to thwart Communist led insurrections in those countries. The governments of Hungary, Poland, Romania, Bulgaria, and Czechoslovakia fell to Communism in quick succession. It became evident that the occupation mission of the forces in Western Europe had changed to one of blocking possible Soviet aggression from overrunning all of Europe.[3] The forces stationed in Europe needed assured supplies and supply lines in the event that the occupation mission went from blocking Soviet aggression to a resumption of war in Europe. Supply support facilities and lines of communications were established in France, Austria, and Italy not only for support to American forces but also to support the fledgling NATO force which came into being in response to the Communist threat from the east.

America had men and materiel in every theater of the war from Europe to India to the Pacific and all points in between. Inventories of the Army Services forces and Army Air Forces, in 1946, showed $14.6 billion and $3.9 billion worth of procurements, respectively, in overseas theaters. The Army had 2,871 fixed installations with an estimated cost of $3.4 billion outside the continental US alone.[4] Certain factors of World War II contributed to especially large amounts of surplus stocks after the fighting stopped. First and foremost was the global nature of the conflict. Stockpiles were generated in separate theaters due to the extremely long lines of communications (table 2). In mid 1945 it took an average of 106 days for delivery of a requisition by US forces in Germany.[5] Delivery schedules such as these also required the supply pipelines to be filled with several months of supplies. These two factors confirmed the need for and the reason behind the development of stockpiles in the various theaters.

TABLE 2

SEA LINES OF COMMUNICATIONS

Supply Seaport of Embarkation	**Supply Seaport of Debarkation**	**Distance in Nautical Miles**
Seattle, Washington	Seward, Alaska	1,232 Miles
Seattle, Washington	Dutch Harbor, Bering Sea	1,707 Miles
Seattle, Washington	Kiska, Aleutian Islands	2,284 Miles
San Francisco, California	Okinawa, Japan	5,615 Miles
San Francisco, California	Manila, Philippines	6,299 Miles
San Francisco, California	Saipan, Guam	5,349 Miles
San Francisco, California	Honolulu, Hawaii	2,091 Miles
San Francisco, California	New Guinea	5,607 Miles
San Francisco, California	Brisbane, Australia	6,193 Miles
San Francisco, California	New Caledonia	5,410 Miles
Los Angeles, California	Calcutta, India	12,163 Miles
Boston, Massachusetts	Reykjavik, Iceland	2,306 Miles
New York, New York	Liverpool, England	3,258 Miles
New York, New York	Antwerp, Belgium	5,523 Miles
New York, New York	Naples, Italy	4,193 Miles
New York, New York	Khorramshar, Persia	8,535 Miles
Hampton Roads, Virginia	Khorramshar, Persia	11,995 Miles
Hampton Roads, Virginia	Bombay, India	11,382 Miles

The outbreak of war in Korea found the US Army without plans for combat and logistical operations. The logistical support plan developed to support the war was developed piecemeal from emergency to emergency. Leftover supplies in the Far East theater from World War II were used initially to supply American Forces in Korea. The materiel stockpiles were so extensive that they sustained forces employed in Korea in the early stages of the war. The method of replenishing the existing stockpile was perpetuated throughout the campaign.[6] Supply and maintenance depots were established in Japan with the line of communication beginning in the US to Japan and into Korea. Japan provided the intermediate staging base for US forces and supplies destined for

Korea. Automatic resupply from Japan to Korea was established during the first several months of the war. The Korean post of Pusan became the main port and the main supply base with relatively few inland intermediate depots in Korea.[7] Again, long lines of communication coupled with the need to keep several months of supplies in the pipeline led to the formation of large stockpiles in the Korean theater of operations. After the Korean War the Air Material Command came up with a concept known as "Logistics for 1956", to overcome some of the logistical problems of the war, which was endorsed by the Chief of Staff in 1953. The package of ideas called for ending the practice of pre-stocking supplies overseas, reducing the workload of overseas depots, and reducing the amount of supplies in the supply pipeline at any given time which was contrary to the belief that the pipeline must always be full. The objective was to place as much of the peacetime stocks as possible in the hands of the operational commands, with the remainder located where they could be made available promptly.[8]

The US Army had combat tested their method of moving mountains of supplies to support deployed forces and it had worked. The American way of war mirrored her economic strength. American industry could produce the war materials required and mass logistics was the logical outgrowth of a mass production economy.[9] To the military in a combat theater items of excess were of little consequence. When movement of the force became necessary and the force could not transport all of their supplies, excesses were left behind. The military at the department level rarely concerned themselves with excesses and when they did it was only if resources used in the production of the excesses caused shortages of some other critically needed item. On the other hand a shortage or even a threat of a shortage would have a critical effect on a campaign. It became expected that excess stocks would accumulate in overseas theaters because it was better to have than have not. The consequences of having too little greatly outweighed the consequences of having too much. Complex organizational structures for Army supply chains existed in each overseas theater during World War II and this practice of "cobbling" together supply organizations carried over into the Korean War. Efforts such as Logistics for 1956 sought to standardize operations and create a baseline of supply support. The magnitude of the DA and DOD inventory, joined with the global responsibilities of the US Army, required standardized policies and procedures for effective management and efficient operations of this large supply system. The US Army institutionalized the lessons learned in World War II and Korea and the stockpile-based supply system was born.

Stockpile-Based Supply System

The stockpile-based supply system used in the Army had definite stockage criteria for items that were stocked. First, there are two basic types of items that the Army keeps in the inventory. Major end items, such as weapon systems, trucks, and aircraft are managed, procured, and issued on the basis of authorization documents, that is, tables of organization and equipment (TOE). Secondary items are essentially items which support major end items such as, repair parts, tools, fuel, and others. Secondary items are managed, procured, and issued based on usage. Historical demand data, captured during the requisitioning process, is used to forecast future requirements. These items have a relatively low unit cost with recurring demands and demand history, and are the nucleus of the stockpile-based supply system.

The Army supply system is divided into wholesale and retail levels similar in nature and scope to elements of private industry. The wholesale level provides centralized management for the entire system. In both government and industry the wholesale level buys from the manufacturer and or industry and provides products to the retail level and other wholesale organizations. The retail level provides materiel support to the user directly and obtains materiel support from the wholesale level.[10] The wholesale level stores materiel to support Army forces worldwide. DOD and or the Army purchases items, stores them in wholesale level depots and at different points within the retail echelon as well, using organizations designed to sustain the uninterrupted operations of the armed forces. Stocks are stored at depots based in part on the geographical source of historical demands and on cost. At the wholesale level this depot inventory consists of war reserves and peacetime operating stocks. War reserve materiel is stock necessary to meet increased training needs and provide for wartime consumption until resupply can be established. Peacetime operating stocks are used for day to day operations, training, and maintenance. Stockage of these items are based on historical demands. Items requisitioned twelve or more times in a 12 month period qualify for stockage at the wholesale level. Items receiving less than twelve demands may be stocked as demand-supported items only if the cost of stocking them is less than or equal to the cost of being out of stock.[11]

Requirements determination is the process by which the wholesale level of the stockpile-based supply system determines the needed stockage levels to satisfy requirements. This is done by forecasting future requirements and ordering replacement material based on historical demand data. Projected receipt of inventory is based on lead-times with the most critical lead-time being the procurement lead-time. Procurement lead-time is the time between the initiation of a procurement and receipt of material. The safety level is the quantity of stock required to permit uninterrupted supply operations. The safety level is determined so the supply system will have a quantity of stocks to permit continued operations if delays occur in procurement, delivery or unexpected increases in demands. A fixed safety level is used at the retail level and a variable safety level is used at the wholesale level. Procurement of material for the wholesale supply system is based on the Wilson Economic Order Quantity as shown in figure 2:

$$Q = \sqrt{\frac{2AS}{rv}}$$

Where:

Q = the quantity ordered (in units)
A = the ordering or set up cost (in $ per order or set up)
S = total inventory costs (in dollars)
r = the annual inventory cost (as a percentage of the product cost or value
v = the average cost or value, per unit, of the product (in dollars)

Figure 2. Wilson Economic Order Quantity Equation. From Nicolas A. GlasKowsky Jr., Robert R. Hudson, and Robert M. Ivie, *Business Logistics: Physical Distribution and Materials Management* (Fort Worth: The Dryden Press, 1992), 145-146.

Because of the lead-time in ordering and receiving materiel, orders for additional stocks are placed before they are actually needed and the time when this occurs is called the reorder point (ROP). The ROP is a decision point and consists of an analysis of the procurement lead-time and safety level. When total assets are equal to or less than the ROP an order is made. Orders are made based on the requirement objective (RO) which represents the maximum amount of stock authorized to be on hand or on order, that is the procurement cycle plus the procurement lead-time plus the safety level requirements.[12]

Inventory control points (ICPs) and depots, each responsible for different commodities, execute the flow of materiel through the wholesale system. The prime directive of materiel flow in the stockpile-based supply system is the ability to receive materiel from a wide variety of sources and the capability of storing materiel in a sufficient number of locations within CONUS and overseas to provide effective support to deploying and or deployed forces. The Defense Logistics Agency manages the wholesale depots and inventory control points and has primary distribution sites in the US at Susequehanna, Pennsylvania in the east and San Joaquin, California in the west.

Stockage of supplies at the retail level uses selective stockage as the criteria for inventory. Selective stockage is based on demand history and keeps the inventory closely matched to the supported customers' needs. The plan is to select and stock fast moving items forward and slower items in the rear.[13] The GSUs and DSUs use a technique called the authorized stockage list (ASL) as their authority to stock particular items and to control on hand inventories. Each item is identified by a stockage list code (SLC) which gives the reason that the item is stocked. The majority of items stocked in the ASL are SLC Q; demand supported. Stocked demand items are added to the ASL when they have had nine recurring demands during the most recent twelve months which is called the control period. Stocked demand items are kept on the ASL if they have had three recurring demands the control period.[14] The requisitioning objective, the maximum quantity of an item that may be on hand or on order, consists of operating, safety, and OST levels and is the maximum quantity of an item that may be on hand or on order at any time. The operating level (OL) quantity is stock needed to sustain supply operations between the receipt of a replenishment shipment and the submission of another replenishment requisition. The order-ship-time level (OSTL) is that quantity of stock required to sustain supply operations between a replenishment requisition and materiel receipt at the supply support activity. The safety level (SL) is that quantity of stock on hand to sustain supply operations in the event that the demand rate accelerates unusually or there is an increase in the OST. The reorder point (ROP), as in the wholesale system, is the decision point to replenish stockage. When the quantity of stock on hand and due in minus due outs to customers is equal to or less than the ROP, a replenishment requisition must be submitted. The ROP is computed by adding the quantities computed for the OSTL and the SL. The economic order quantity method of stockage may be used but the days of supply (DOS) method of stockage is preferred in direct support retail operations. The DOS stockage method computes stockage for a given number of days based on daily use or demand rate.[15]

The Army divides its retail supply operations into two parts, operational and tactical. The types of units that perform the operational and tactical functions are called general supply units (GSUs) and direct supply units (DSUs), respectively. This delineation of units is based on functions performed and not location. The location of the supply units on the battlefield is determined by the tasks performed, the echelons they support, and the areas in which they support. GSUs perform a wholesale function by supplying only DSUs with DSUs supplying materiel directly to users. One of the principal requirements of this hierarchical system is the "umbrella concept". The umbrella concept requires the higher level of supply, the GSUs, to stock all items that its lower customers, DSUs, have in stock. The users, DSUs, and GSUs are tied together in a habitual support to supported relationships. Units requiring supplies requisition support from their supporting DSUs and if the DSU has the item on hand, issues it to the unit. If not the requisition is passed to the DSU's supporting materiel management center (MMC). The MMCs at each echelon of support, division, corps, the old theater army area command and theater, will attempt to fill the requisitions with stocks available in its area of responsibility.[16] The hierarchical system dictates that each echelon of support pass the unfilled requisition backwards through its logistical support channels until filled and if necessary, by inventory control points located in the US. These material managers are responsible for performing, monitoring, and tracking performance of the supply flow through the stockpile-based supply system.

Distribution-Based Supply System

Lieutenant General Joseph Heiser Jr., DCSLOG of the Army, 1970-1972, initially introduced the concept of a distribution-based supply system, as part of the Army Logistics Offensive in the late 1960s and early 1970s. The Logistics Offensive began when the then Major General Heiser was the commander of the 1st Logistics Command, Republic of South Vietnam, 1969, and carried over into his tenure as the Deputy Chief of Staff for Logistics from 1970 until 1972. The offensive was begun to overcome the supply problems experienced during the Vietnam War. The US supply experience during Vietnam mirrored it past supply efforts particularly the Korean War. Supplies were "pushed" into the theater from the strategic sustaining base in the US. The national inventory control points (NICPs) worked to distribute to the theater as much property as possible. The depots distributed supplies in advance of known requirements and overwhelmed the reception facilities and personnel. A vast amount of items arrived without documentation further compounding the problem. The Logistics Offensive was developed as the prime management technique to alleviate these and other problems as well as integrate and coordinate the many aspects and functions of logistics operations.[17] It identified major areas in which improvements were required, then divided those areas into projects that were further subdivided into tasks. The overall objectives of the offensive were improvement of the effectiveness and efficiency of logistics operations at an accelerated rate. One of these major areas was a management technique developed in Vietnam to initially manage ammunition supply, but which quickly spread to other commodities because of its success, called "Inventory in Motion". Inventory in motion minimized the need for large stockpiles at intermediate depots in the theater of operations. Prior to the inventory in motion concept items were counted as inventory at the NICPs at the beginning of the supply chain and once again at the end of the supply chain at some direct support unit in the theater of operation. The supplies were not counted as inventory while intransit through the supply pipeline and there was very little visibility throughout the supply chain. Inventory in motion used the improved technology of the day such as communications, transportation, and computer capability controlled by improved command management, to provide intransit logistics intelligence to better account for supplies in the pipeline and on the ground at echelons in theater. Inventory in motion was the first attempt to integrate the transportation and supply functions of logistics by monitoring and controlling items in transit, static stocks, and reducing stock levels at various echelons in theater.

Lieutenant General Heiser's inventory in motion concept coupled with his "Operation Streamline" were designed to eliminate unnecessary stocks and supply echelons. Business practices were changed to reduce OST thus accelerating direct delivery to direct and general support units using logistics intelligence and asset control.[18] The Logistics Offensive was the first time that systemwide solutions were attempted to correct the shortcomings in the supply system. Those initiatives were the precursors of the 1990s' distribution-based supply system that grew out of logistical experiences during the Operations Desert Shield and Storm.

Following the Gulf War logisticians began to critically analyze the lessons learned from the various phases of the conflict. Although Desert Shield and Storm were enormously successful tactically and proved that the AirLand Battle was in fact the correct doctrine, the logisticians noticed that there were glaring deficiencies in logistics processes and applications. The logistical support of the war was tremendous but relied on "brute force" to accomplish the mission. The military, just as it has done in previous overseas wartime theaters, overwhelmed the ports of debarkation with cargo and personnel. Though Saudi Arabia had modern seaports, airports, and a limited number of modern roadways capable of receiving the deploying forces, there was no logistical infrastructure to feed, shelter and supply a force of the size being assembled.[19] Adding to this lack of infrastructure was the insufficient number logistical personnel to receive the soldiers and equipment, which deployed into theater. The pace of unit deployments was not synchronized well enough to link personnel deployed by airlift to coincide with the arrival of unit equipment deployed by sealift.

Complicating the port overflow was the lack of asset visibility for the twenty-foot and forty-foot containers shipped into theater. Multiple coassignee loads were packed into a single forty-foot container until the container was filled. While this procedure ensured that the limited shipping capability would be used to capacity, it created severe problems on the receiving end once the containers arrived in theater. A large number of containers did not match the documentation on the ship's manifest. Some 28,000 of the 41,000 arriving containers had to be opened right on the docks when they arrived to figure out what was in them and where they needed to go.[20] Somewhere between twenty and thirty thousand containers and uncounted air pallets had to be opened every time someone wanted to know what was inside, where something was, or who was supposed to get a container. The military simply lost visibility of much of that cargo. As a result, unit equipment did not always get where it was supposed to go, certainly not by the time it was needed; sustainment supplies were requisitioned two or three times and were not available to the forces when needed.[21]

Several Army organizations, primarily the Army Materiel Command (AMC), US Army Combined Arms Support Command (USACASCOM) and Headquarters, Department of the Army, Office of the Deputy Chief of Staff for Logistics (ODCSLOG) began to explore initiatives to radically improve supply operations after the Gulf War. They came to the realization that the massed based logistics system had to dramatically change to sustain a force projection Army and to keep pace with technology and commercial practices. Their combined efforts focused on a holistic Revolution in Military Logistics (RML) to coincide with the Revolution in Military Affairs. The RML seeks ways to reduce the logistical burden to the Army and is centered on three domains; technology application and acquisition agility, force projection, and force sustainment.

Force sustainment under RML replaces mass with velocity and transforms the stockpile-based supply system or a system based on massive stockpiles at every echelon, to a distribution-based supply system. The goal is to replace the mass-based system, with its built in system redundancies, by making the logistical footprint smaller, compacting the system. Reductions in the length of the supply chain will be accomplished with OST improvements and elimination of inventory duplications. The key to increasing velocity is the quick understanding of requirements and assets. To achieve this quickness the system must rely on assured communications and automation.[22]

The intellectual underpinning of the Army's distribution-based supply system is commercial industry's just-in-time (JIT) business practice of purchase and supply. JIT was first introduced in Japan in the late 1970s, and its objectives was the streamlining of material flow to the manufacturer, elimination of manufacturers' supply inventory, which in turn reduces manufacturer and supplier cost. The JIT business practice also purports to increase quality and service by creating long-term relationships with chosen suppliers creating a cooperative venture between manufacturer and supplier.[23] The Army sees JIT, in the theoretical realm, as one method to assist in the reduction of its inventory, lowering cost, removing mass, and increasing velocity.

Comparative Analysis

Asset Visibility

Stockpile-Based Supply System

The stockpile-based supply system used requisitions from units, DSUs, and GSUs, to gain asset visibility over supplies in the pipeline. Requisitions flowed from overseas or CONUS SSAs to the MMC or CONUS installation supply division (ISD) for editing and validating the supply data, funding, and fill rate data in accordance with the prescribed fill or pass to higher level of supply logic. The MMC or ISD then transmitted the requisitions through the Defense Automatic Addressing System (DAAS) for routing to the appropriate ICP.[24] The requirement might have to go through several echelons of support and review on its way to the ICP.

DAAS is an automated system for routing logistics data traffic and provided document processing and data information services. It uses communications provided by the automatic digital network (AUTODIN) and the defense data network (DDN) worldwide DOD computerized general purposes communications systems. The DAAS performed as an automated document distribution system. It validated, edited, and routed logistics documents. The DAAS was the primary data communication service for logistics traffic and provided common logistics communication between customers, ICPs, and depots.[25]

The ICP transmitted materiel release orders through the DAAS to the area oriented depot serving the requisitioner directing the depot to ship the item to the customer. The depot selected the materiel, consolidated it whenever possible and sent a materiel release confirmation through the DAAS to the ICP, and shipped the materiel to the installation central receiving point (CRP).

The CRP received all shipments of materiel from commercial vendors, parcel post, and the military system. When all materiel on a particular conveyance were for one or a few customers the materiel was delivered directly to those customers after inspection by the CRP. The CRP reported the arrival of the conveyance and the SSA, GSU or DSU, reported the receipt of the materiel.

An image copy of the initial requisition passing thorough the DAAS was also routed to the Logistics Control Activity (LCA) for inclusion into the Logistics Intelligence File (LIF). The LCA's, an AMC activity, mission was to provide valid logistics status of a requisition or a shipment regardless of its location in the pipeline, to GSUs and DSUs in the field. All subsequent transaction relating to the particular requisition was also routed into the LIF to provide current status and visibility of the requisition.[26]

The LIF is a centralized database providing visibility of supply and transportation actions for requisitions placed on the wholesale system. As materiel moves through the pipeline, to Army customers worldwide, automated supply and transportation systems fed the LIF current status on the location of the materiel. The LIF provided a quick reference to requisition status, shipping information, and receipt of materiel requisitioned. The LIF was the database for reporting OST performance. As the data aged, it became a historical database used for forecasting overocean lift requirements and for measuring efficiency of the Army supply and transportation pipeline. The LIF was used to frustrate, divert or reconstitute lost cargo.

Figure 3 portrays the life cycle of and Army sponsored requisition from an overseas SSA as it moved through the wholesale supply and transportation systems. The arrows from the various segments of the pipeline to the LIF depict the flow of data from these segments. This illustrates the asset visibility of the stockpile-based supply system. DAAS provided an image copy for the LIF input during the supply phase. Once the materiel movement segment begins, transportation and receipt data are provided directly to the LIF. The requisition cycle is closed when the D6S, receipt detail card, is submitted to the LIF by the SSA. This card shows the date the master inventory record posting was accomplished making the materiel available for issue to the customer. A CONUS requisition was handled in the same manner with the exception of the consolidation and or containerization point, port of embarkation, or debarkation segments. Asset visibility was extremely dependent on the intelligence gathering efforts as well as the diligence of personnel working at MMCs, SSAs, ICPs, CRPs, depots, and the transportation system.

Customers of the stockpile-based supply system had very little if any visibility on individual requisitions. These customers were dependent on their supporting DSU for status which was dependent on its GSU and or its MMC, for status. Accessing the LIF required a password, dedicated class A telephone, capable of accessing the AUTOVON telephone network, and a working knowledge of the LIF procedures. When a unit, DSU, or GSU, contacted the LIF they could not determine where their requisition was in the chain. Visibility of requisitions by material managers was frustrated when requisitions made a mode change, rail to road for example, or between ICPs and depots. The MMC was the interface between the retail and wholesale level and was the only organization "authorized" to contact item managers at ICPs or depots. The LCA reconciled open

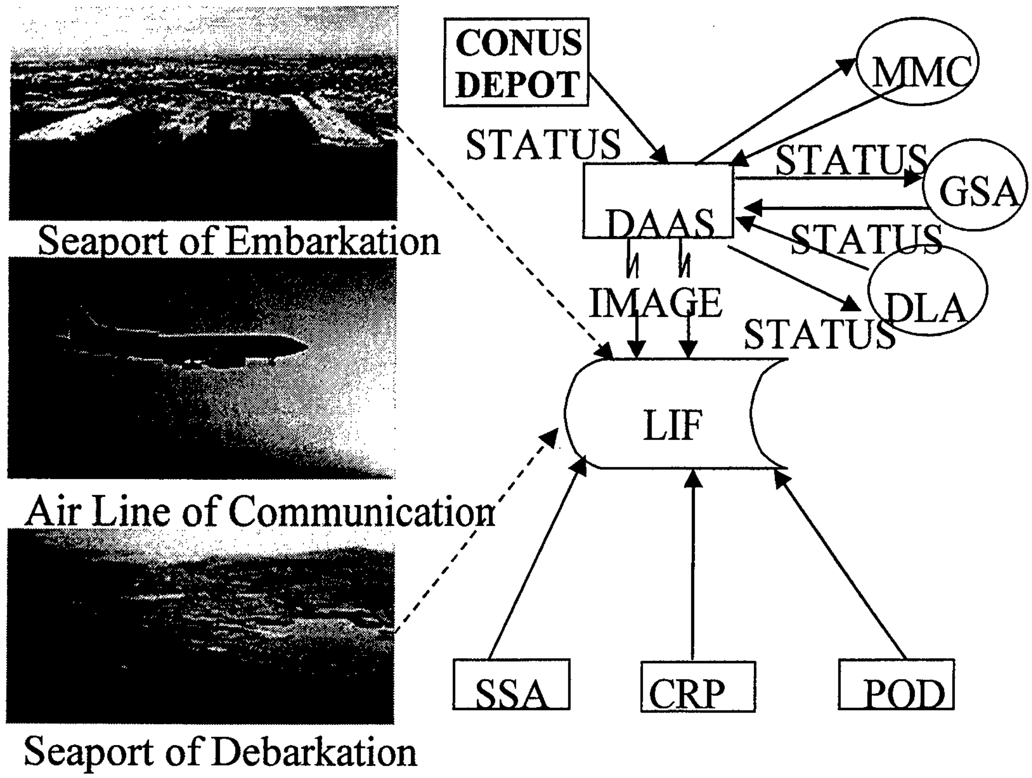

Figure 3. How the LIF is built. Photos from USACASCOM, Rock Drill Photo Gallery, Distribution Laboratory, Fort Lee, 1998.

requisitions on a quarterly basis with supply sources and customers. A bottoms up reconciliation was conducted where each SSA reviewed its open requisitions and then passed them to their supporting ISD and or MMC which reconciled the mismatches with the wholesale system. When record mismatches occurred between LCA and the ISD or MMC a "follow-up" action was passed to the wholesale system. Follow-ups did not mean that the supply would be issued but rather that research would begin to determine where the supplies were lost in the chain, admitting a lack of asset visibility. Retail level SSAs were required to have their customer units validate and reconcile open supply requests monthly.

SSAs were also required to validate all requisitions not validated by the customer unit and reconcile all requisitions sent to the next higher source of supply monthly as well. The delays in the system coupled with the rational actions of the requester duplicated the classic beer game.[27] This simulation of a production and distribution system traces the reaction and behavior of customers, suppliers, and manufacturers as delays occur in the system. When the system does not produce results as expected the customers, suppliers, and manufacturers act rationally and place greater demands on the system.[28] Less visibility meant more requisitions, multiple echelons of support, the proliferation of automation tools within each functional area, "stovepiped" information, information which is only available to one organization or through one channel, and a bureaucratic reconciliation process prevented real-time or near-real-time asset visibility.

Asset Visibility

Distribution-Based Supply System

The distribution-based supply system also uses the LIF data base to provide logistical pipeline information for supply and transportation data on requisitions. The LIF is a centralized database providing visibility of supply and transportation actions for requisitions placed on the wholesale system. As materiel moves through the pipeline, to Army customers worldwide, automated supply and transportation systems feed the LIF current status on the location of the materiel. The LIF provides a quick reference to requisition status, shipping information, and receipt of materiel requisitioned. The LIF is the database for reporting Army Velocity Management and OST performance. As data ages, it becomes a historical database used for forecasting over the ocean lift requirements and for measuring efficiency of the Army supply and transportation pipeline. LIF serves as the Army's single database for supply and transportation actions. The LIF may be viewed and accessed by customers in a number of ways either via, telecommunications network (TELNET), Direct Dial, or Defense Data Network, or through other systems such as Army Total Asset Visibility (ATAV) and the Integrated Analysis Program (ILAP), and provides real-time asset visibility.

Radio Frequency-Automatic Identification Technology (RF- AIT) is the heart of the distribution-based supply system's asset visibility. RF-AIT is the use of electronic devices to track materiel in the pipeline, intransit visibility, and to do away with the requirement to manually enter most receipt and selected inventory transactions into automated systems.[29] RF-AIT is a way to package information to track and identify items in the logistics pipeline. The AIT equipment consists primarily of small electronic devices, called RF tags and Interrogators.

The RF-AIT equipment is used at the point of origin to write cargo data to the tag, and report the same information to a central database. While transiting through the logistics pipeline using RF-AIT equipment, the tag number along with a date time stamp is recorded at various points. This information is passed to the central database and all transit records are updated. At the final destination before direct distribution to the user, the AIT equipment reports the arrival at the destination to the central database.[30]

Radio Frequency tag (RF TAG) is a device that contains a microchip, a long-lived battery, a simple RF receiver, and a RF transmitter. The microchip is loaded with data about the cargo, such as shipper, destination, requester, and other information. When it receives the properly coded RF signal from an AIT data interrogator, it transmits its contents on a preset frequency. The RF TAGs are mounted on containers transiting through the logistics pipeline. Supply and transportation documentation, such as transportation control movement documents (TCMD), packing list, and container description is written to and stored on the electronic RF TAG. Later, the tag can be read by interrogators at various points in the pipeline to check the status and location of the container. The electronic tags and interrogators use radio frequency technology to communicate so that direct contact between the tag and the reader is not required. Eventually, they will be attached to all shipments in the supply system and the transportation system to provide asset visibility and intransit visibility. In the current configuration, a RF tag will carry 128 kilobytes of data, which allows it to carry detailed information about the contents of a container. This allows automatic inquiries into container contents and automated generation of receipt transactions.[31]

The RF TAG is the electronic equivalent of a bar code label. It is a combination of computer, database, controller and two-way communication device that is attached to a shipping container, air pallet or vehicles. It is used to provide "inside the box" visibility as well as intransit visibility of conveyances or platforms.

The AIT Data Interrogator device exists at direct support supply activities, direct support maintenance activities with a supply mission, CRPs, and at selected points within transportation networks. The AIT Data Interrogator transmits queries to and receives data from all RF TAGs in its area. It is connected directly to the Standard Army Retail Supply System-1 (SARSS-1), Standard Army Maintenance System (SAMS-1), Unit Level Logistics System-S4 (ULLS-S4), and Unit Level Logistics System-Ground (ULLS-G). It also passes data to transportation systems such as Transportation Corps Automated Command and Control Information System (TC ACCIS) and Transportation

Coordinators' Automated Information for Movements System II (TC AIMS II). When the tag passes a fixed or handheld interrogator, the tag downloads its identity to the interrogator. The interrogator then passes the data to a central database via the Transportation Resource Accounting and Phone Reporting System (TRAPR) and the Transportation Resource Accounting and Satellite Reporting System (TRASR). The TRAPR is a communications device which is placed at key transportation and supply nodes and reports the passage of tagged items to the centralized database. The TRASR consists of satellite communications, global positioning system receiver, and a laptop computer. The TRASR is used to provide ITV data in austere environments where there are no telephones. RF interrogators, which are attached to gate posts or other checkpoints on a given route, pass tag number and location information to a DOD satellite.[32]

This technology give the distribution-based supply system total asset visibility (TAV) during end-to-end pipeline movement, easily accessible by customers and distribution managers alike. During each segment of the pipeline various databases are employed to monitor movement. The TAV capability is created by fusing data retrieved from DOD legacy systems. The global transportation network (GTN) is the data base that records and archives strategic unit and supply movement. Sealift visibility is provided by the worldwide port system (WPS) which captures vessel stow plans and advanced manifest information. Airlift visibility is captured by the computerized aerial port system (CAPS) which documents cargoes airlifted to a theater of operation. In-theater visibility, which consists of aerial port of debarkation (APOD) or seaport of debarkation (SPOD) to the cosignee, port, airhead, or SSA, enroute and transition node visibility is accomplished by AIT.[33] Distribution managers access all of this real-time data to achieve TAV. TAV gives timely and accurate information on the location; movement; status; and identity of units, personnel, equipment, and supplies and allows distribution managers to make informed decisions for better support. Users of the distribution-based supply system can now track supplies to the individual requisition or pallet number. They can also make inquiries on specific kinds of equipment. Logistics personnel can query the database to determine the location of a given vehicle and the cargo it is carrying. With a monitor station, a user can zoom in on a particular RF TAG and track it across a map. Users can also query the tag to pull up a list of the contents which come from a central database.[34] Users will refrain from clogging the supply system with additional requisitions because of the improved visibility. The supply system will build trust with customers who now have access to the logistical pipeline.

Logistics Response Time

Stockpile-Based Supply System

The stockpile-based supply system had time standards for each segment of the logistical pipeline. The system was measured in days of delivery from the time that a customer requisitioned an item until they received that item. The Uniform Materiel Movement and Issue Priority System (UMMIPS) prescribed guidance for the proper ranking of materiel requirements.[35] Several factors impacted the OST such as geographic location, force activity designators, (FAD), urgency of need designators (UND), with A meaning "must have," B meaning "mission impaired," C meaning a "routine replenishment" and priority designators (PD).[36] The FAD indicates the mission essentiality of the unit, the UND reflects the immediate importance of the requisition, and the PD noted to the system in what priority to fill the requisition with lower PDs receiving precedence (table 3). The PD has time standards associated with it, which provides response times for each segment of the logistical pipeline (table 4) in satisfying

TABLE 3

DERIVATION OF PRIORITY DESIGNATORS

Force Activity Designator	Urgency of Need Designator	Urgency of Need Designator	Urgency of Need Designator
	A	B	C
I	01	04	11
II	02	05	12
III	03	06	13
IV	04	07	14
V	05	08	15

Source: Derivation of Priority Designators from the US Army Logistics Management College, Text ALM-48-5240-LC(G), *Physical Distribution Management Overview* (Fort Lee: US Government Printing Office, 1993), 1-9.

customers' demands. The DOD has developed a set of standards pertaining to resupply operations. These standards vary by priority and by region. Table 5 reflects these standards for three priority categories and three areas.[37] The standard for shipment in the United States is five days for the highest-priority cargo, and an average from all depots of sixty-five days for the lowest priority to the Western Pacific. Given that numerous commercial companies will guarantee overnight delivery in the United States and two days overseas, these standards do not seem challenging. In 1959, the standard for high-priority shipment in the United States was six days, and the low-priority shipments were allowed twenty days. As low as the standards are, in comparison to industry, DOD failed to meet them during the Gulf War. An analysis of the pipeline performance showed that

TABLE 4

PIPELINE STANDARDS

UMMIPS	Total Pipeline Standard in Days		
	PD 01-08	PD 01-08	PD 09-15
Rqn Sub Time	1	1	2
Passing Action	.5	1	1
ICP Avail Determ	1	1	1
Depot/Storage Site Procure	1	1	5
Trans Hold & CONUS Intransit	1	4	10
Overseas Delivery	4-8	4-9	28-61
Receipt Pickup	.5	1	3
Total Pipeline	5-13	9-18	22-83

Source: Pipeline Standards from US Army, Logistics Management College, Text ALM-48-5240-LC(G), 1-9.

TABLE 5

UMMIPS STANDARDS BY REGION

	Priority Designators		
Destination	Highest	Middle	Lowest
	01-03	04-08	09-15
United States	5	9	22
Mediterranean	9	13	55
Western Pacific	10	14	65

Source: UMMIPS Standards by Region from John M. Halliday and Nancy Y. Moore, *Material Distribution: Improving Support to Army Operations in Peace and War* (Santa Monica: RAND Corporation, 1994), 4.

only seventeen percent of the highest priority shipments in the United States met the high-priority standard of five days.[38] More than one-third of the lowest priority overseas shipments, PD 09-15, which standard was fifty-five to sixty-five days, took longer than the maximum standard. Data collected from Operation Desert Storm indicated the system performed worse. High-priority shipments took an average of thirty days, or more than three times as long as the standard. Each segment of the process, from placing a requisition for an item to receiving the package and every step in between, was slow and unreliable. While standard OST existed, orders varied widely; some orders were delivered in a few days, but others took weeks, even when the ordered items were in stock. Routine replenishments were filled before higher priority requisitions. An ironic twist in the system occurred as users became more frustrated and began to flood the system with high-priority requisitions, the wholesale system responded with first-in-first-out (FIFO). All high-priority requisitions meant no high-priority requisitions and the system picked routine replenishments in their place. The stockpile-based supply system, because of its complexity, was difficult to monitor and control individual segment deviations and systemwide failures. A lack of confidence in the reliability of the order-ship process led Army personnel to hoard supplies and place duplicate orders. The system was unresponsive during peacetime and war. The system was not designed for high performance and consistently failed to meet the minimum standards it set for itself.

Logistics Response Time

Distribution-Based Supply Time

Following the Gulf War the Army realized that a new approach was needed to achieve change. In 1995, with the analytic support of the RAND Corporation, the Army implemented the VM initiative, which adapted many of the technological and managerial innovations that had proved successful in the commercial sector, to the military. [39] The Army improved the effectiveness and efficiency of the order and ship process under the VM initiative. First the process was defined, identifying each step involved, from the original request to the delivery of the part to the SSA. Then the process was measured. The measurement was intended not only to understand current performance but also to help diagnose sources of poor performance and to monitor improvement efforts. Average times, the traditional metric, were not used. Logisticians analyzed and reported OST at the 50th (median), 75th, and 95th percentiles, metrics that revealed the process was not only slow but also highly variable. Working with DLA and commercial shippers, they next set out to improve the process, eliminating some steps, collapsing others, and better coordinating still others. Figure 4 shows the median OST (bottom segment of the bar) decreased from eighteen to eight days over a few months after VM was implemented. Moreover, reduced OST lessened time spent awaiting parts, speeding repairs, and improving equipment availability from eight-five to ninety-five percent.[40]

The definition and measurement stages showed that many of the process segments were being managed with metric goals that resulted in the apparent efficient use of some resources at the overall expense of the whole. For example, some organizations and the segments managed by those organizations measured themselves by the efficient use of trucks, so partial truckloads were held up until a full one could be assembled. While this goal and this metric yielded more efficient use of trucks, it delayed getting the needed

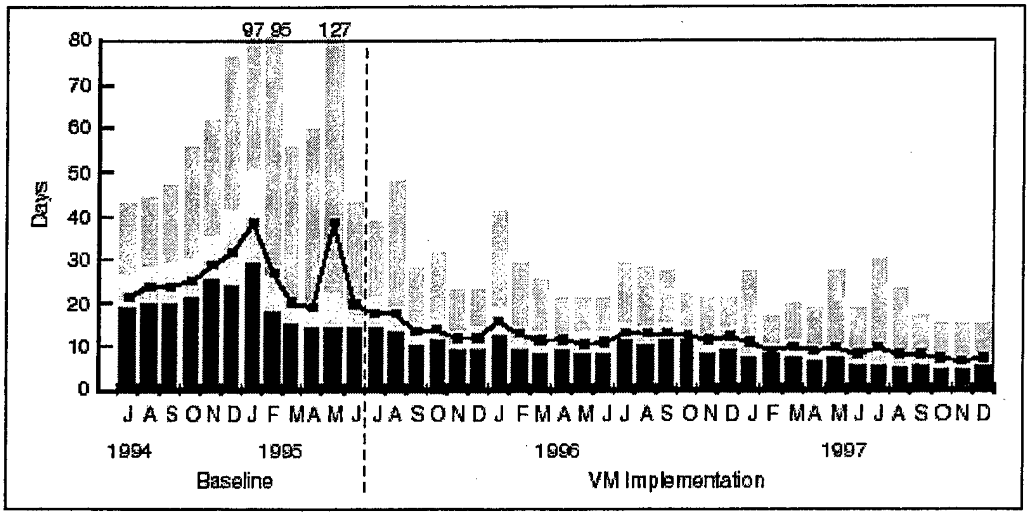

Figure 4. Improvements in OST at Fort Bragg. From RAND Corporation, *Speeding the Flow: How the Army Cut Order Ship Time* (Santa Monica: RAND Corporation, 1998), 4.

part to the customer and lengthened OST for many orders. Once these process improvements were identified, the Army implemented changes in that portion of the supply chain where the Army had control. Army installations strengthened oversight, simplified rules, improved the use of new requisitioning and receipting technologies, reduced review processes, streamlined on-post delivery, and made use of the information available from the new metrics.

Figure 5 shows how OST has declined as a result. The bars represent the monthly OST performance for orders for repair parts (Class IX supply) placed by active units in the continental United States and filled by the wholesale supply system. The vertical dashed line distinguishes two periods of performance. The period from July 1995 through December 1997 represents performance trends since the VM initiative took hold.[41] The twelve preceding months, July 1994 to June 1995, is the baseline period and serves as the basis of comparison for gauging progress. The segments on each bar measure the month's OST performance at the 50th, 75th, and the 95th percentiles. The 50th percentile indicates the day by which 50 percent of the orders are filled, the 75th percent, and so on. The line running through all the bars is the average OST.

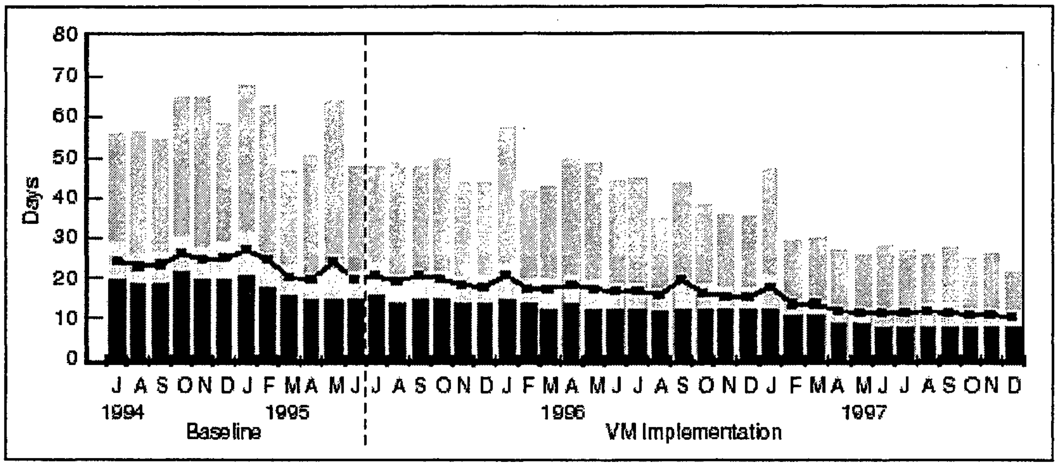

Figure 5. Order-Ship-Times in CONUS. From RAND Corporation, *Speeding the Flow: How the Army Cut Order Ship Time*, 3.

As shown by the continuing downward slope of the bars and line, the Army has made dramatic and nearly continuous improvements in the order and ship process under VM. The performance during the baseline period for the three percentiles was seventeen, twenty-five, and fifty-six days for the 50th, 75th, and 95th percentiles respectively, with an average OST of just over twenty-two days. Corresponding figures for Dwecember 1997 were eight, thirteen, and twenty-five days, with an average OST of under eleven days, in short, approximately a fifty percent reduction at all percentiles. Clearly VM is reducing the logistics response time in the distribution-based supply system.

Metrics

Stockpile-Based Supply System

The stockpile-based supply system measured performance by evaluating a combination of unit performance standards (Table 6), supply support activity performance standards (table 7), and the use of military supply and transportation evaluation procedures (MILSTEP). MILSTEP is the standard procedure used to evaluate the supply and transportation phases of the logistics system. It measures the seven pipeline segments established under UMMIPS. The uniform DOD-wide logistics analysis reports produced by MILSTEP are used by the ICPs, depots, Service Agency headquarters, and the Office of the Secretary of Defense.[42]

TABLE 6

UNIT PERFORMANCE STANDARDS

Management Measure	Objective	Management Level
Processing Time (calendar days):		
Request processing time	2 days	4 days or less
Receipt processing time	1 day	3 days or less
Issue processing time	2 days	4 days or less
Turn-in processing time	5 days	10 days or less
Turn-in receipt processing time	1 day	3 days or less
Document accuracy:		
Supply request accuracy	100%	95 to 100%

Source: Department of the Army Regulation 710-2, *Inventory Management Supply Policy Below the Wholesale Level* (Washington: US Government Printing Office, 1994), 7.

MILSTEP measured the distribution pipeline in segments from the date of the requisition to the date the requisitioner receives the materiel (table 4). MILSTEP analysis uses data generated by the military standard requisitioning and issue procedures (MILSTRIP), the military standard transaction and accounting procedures (MILSTRAP), and the military standard transportation and movement procedures (MILSTAMP) transactions. The time standards prescribed by UMMIPS are the baseline for on-time performance.

TABLE 7

SSA PERFORMANCE STANDARDS

Measure	Objective	Management	MTOE SSA	Installation SSA
Demand satisfaction	75%	70-80%	X	X
Zero balance w/DO	8%	8-10%	X	X
Materiel release denial	1%	0-3%	X	X
Inventory accuracy	95%	85%	X	X
Receipt Processing	3 days	5 days	X	X
Request processing	2 days	4 days	X	X
Location survey	98%	95%	X	X
Inventory adjustment	2.5% of RO dollar value		X	X
UMMIPS:				
PD 1-3	5%	10%	X	X
PD 1-8	15%	20%	X	X

Source: Department of the Army Regulation 710-2, 8.

MILSTEP applies to transactions that are part of the wholesale system and does not apply to retail activities at the installation level. MILSTEP evaluates performance in terms of indices such as on-time deliveries, stock availability, transaction volume, age of backorders, and others. MILSTEP does not obtain supply status or trace shipments. The focus of the collecting, processing, and analyzing data is the evaluation of the stockpile-based supply system's distribution operations. The OST analysis at the retail level is as close as the customer units get to influence and observe the performance of the system. By segmenting the analysis process systemwide deficiencies are difficult to discern. Also, adjusting individual segments of the supply pipeline do not guarantee systemwide performance improvements. Some segment improvements are in direct conflict with each other such as filling a cargo truck shipment bound for an installation, which maximizes cargo capacity versus sending a scheduled daily delivery of cargo to the installation, which reduces OST. The emphasis on metrics in the stockpile-based supply system was on the system and not on the customer units.

Metrics

Distribution-Based Supply System

The customer units drive the logistics process but in the stockpile-based supply system the customer was not in the driver's seat of the logistics effort. No company in the private sector could attract and maintain customers by offering to fill 85 percent of orders in twenty-eight days in the United States and sixty-five days overseas.[43] The accepted performance standards were never measured from the external customer's performance standard but rather they were measured against internal system processes standards.

A supply system that does not have the logistics performance metric of customer wait time as its base is not a valid system in today's fast highly technologically advanced environment. Long customer wait times in the private sector result in customers going elsewhere for better service.[44] The DOD customers do not have that luxury but the customer frustration can be observed in the demands for the reduction of the non-responsive logistical infrastructure. The total time the customer must wait, from requisition date until receipt of materiel, should be the basic metric of the new distribution-based supply system. Inherent in this metric is also a measurement of request accuracy. Mistakes such as entering in the wrong stock and or part number, unit of issue, incorrect address, and other such attention to detail mistakes, will result in longer customer wait times.

Another metric to measure the performance of the distribution-based supply system is the concept of cross-docking. Cross-docking is the direct flow of inventory items through a distribution center from the receiving function to the shipping function and eliminating any steps in between without any storing and staging.[45] This eliminates intermediate handling and storage functions along with their associated costs in dollars, facilities, and personnel. Cross-docking is used in conjunction with the improved communications and information systems and will allow for the reduction of logistics cycle time by decreasing customer wait time. Cross-docking will also streamline logistics infrastructure by reducing storage and staging facilities and their associated personnel.

Time of Ownership (TOO) is a relatively simple manufacturing idea which can be used as a tool to measure performance of those parts of the supply chain that are under direct control of the SSA, Distribution Management Centers, depots, ICPs, and others. The TOO unit of measure is time, the start and finish time, that an item of inventory are under an activity's control.[46] The transportation network helps to define a minimum TOO where reductions will likely be achieved by shortening the time and or distance between sources and customers. TOO is a system measurement that equates time with costs of inventory handling and highlights when and where business processes should be reengineered.

Time definite delivery is a metric that seeks to standardize the delivery of certain items and or standardize the items based on the customer's priority in UMMIPS. Time definite delivery will restore confidence in the supply chain by normalizing delivery schedules and customer wait times. In chapter 2 it was noted that while on-time delivery was essential to an effective supply chain operation, consistency of deliveries was more important than merely going faster. Time definite delivery will require access to dedicated transportation and innovations such as partnering with industry and the use of existing commercial distribution systems.

Establishing the customer as the focal point of the distribution-based supply system should be the linchpin of the distribution strategy. Customer units require responsiveness, reduced logistics cycle time where inventory moves nearly as fast as information, and reliability, with a high level of service that meets or exceeds customer expectations.

Conclusion and Transition

Chapter 4 compared the stockpile-based supply sytem with the distribution-based supply system in two critical areas; asset visibility and logistics response time. This chapter also reviewed the metrics used in the stockpile-based system and suggested new metrics for the distribution-based supply system. The preliminary evidence indicates that the distribution-based supply system increases support to the warfighter by allowing increased visibility over sustainment stocks and equipment and reduction in the logistics response time by reengineering the logistics processes. Chapter 5, will discuss the significance of this outcome along with recommendations for further research.

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CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The structure of the entire Army distribution process in the stockpile-based supply system is complex and segmented. It is complex because it involves many nodes, organizations, data systems involved, and the measure of effectiveness at each node. The DOD Uniform Materiel Movement and Issue Priority System (UMMIPS) standards apply at each step, but they are only one of many measures at each node. The process is segmented because the functional aspects of distribution, for example, storage, issue, and transport are divided among various organizations. Some fall to transportation organizations, others to supply agencies. Some functions occur within Services, and others belong to joint organizations. The process is a patchwork quilt of functions and responsibilities that optimizes component parts at the expense of system efficiency.[1] It is not an integrated activity.

Furthermore, the stockpile-based supply system distribution process has a fragmented focus. Many of the nodes measure performance differently, and none uses what industry regards as the most important measure, customer satisfaction. Some elements use time, others use percentage of fill, and still others use cost. The Army does measure OST at the Department of the Army level but reports performance only by averages, not by individual shipments. However, the Army supply system exists for only one reason: to place requested materiel in the hands of the warfighter in a timely fashion. User satisfaction must be the predominant performance measure. The desired standard is the right materiel in the right place at the right time, every time, with customer wait time as the most important performance metric.

The users of the process also contribute to its poor performance. Because the process functions poorly, those involved have no confidence in it and take adaptive but entirely rational action to improve performance. For example, when the system responds slowly or when users move or cannot find their requisitions in the system, they resubmit requests, further clogging the system. This behavior drives up the cost of inventory and decreases capability. Inventory cost goes up because more items are requested than are needed. Simultaneously, the supply system, seeing more demands, stocks more items. The sluggishness of the system has the effect of increasing the length of the pipeline and, hence, the number of items in it. All of this has the aggregate effect of raising the cost of a given capability.[2] The end result is a lack of confidence by the users in the system.

Transforming the supply system into a distribution-based supply system force will require major changes in doctrine, organization, and mindset. In fact, the strategic motivations for transforming the supply system are strong and involve both opportunity and necessity. On the opportunity side, transformation will exploit the US advantage in creating and applying information technology to create focused logistics. Focused logistics will incorporate information technologies to transition from the rigid vertical organizations of the past to a horizontal, flattened structure.[3]

US technological strengths can, when leveraged with high-quality military personnel, enable the United States to project power globally and to prevail decisively in most military contingencies with logistical forces that are smaller but even more effective. Technological enablers, of course, are not enough. The need to develop, test, and implement concepts for harnessing technology effectively are critical to the success of the distribution-based supply system.

Transformation is also a necessity. The current US logistical force structure cannot be maintained within likely budget levels. The shift to smaller but more capable forces is necessary to avoid losing capabilities and reducing US ability to provide focused logistics to sustain dominant maneuver.

The Army needs to discard the outmoded "push system" of supplying combat forces. The push system distribution approach, which is the typical strategic logistical approach to contingency operations, is used initially to provide supplies to combat forces in advance of known requirements. A push supply system methodology in supply distribution is where inventory is shipped in advance of demand and stored in field locations waiting customer demands. At first, in contingency operations, there is a great deal of movement but very little control. Normal requisitioning and issuing procedures are suspended. Supply and resupply are put on automatic. The NICPs work to distribute to the theater as much materiel as possible. During this push there is a loss of control of the flow of materiel.[4] Contingency operations, which arise unexpectedly, require more control than daily resupply but inversely receive less control because of the perceived urgency. A pull system, where inventory is only shipped to meet customer demands as they occur, is more in line with the tremendous strides made in communication and information technologies. This change in mindset of push logistics, which is used when forecasting methods are not as well developed, will require a major institutional shift within the Army. The decades of reliance on mass and personnel to work around distribution problems must be overcome. The transition to a pull supply system utilizing the latest communications and information technology to precisely determine when and where demands are occurring is the natural outgrowth of the asset visibility inherent in the distribution-based supply system.

Knowledge of what is in the pipeline however, will not overrule or overturn the law of physics or what is known in the supply world as the time-distance factor. Items will require time to travel the distance to the ultimate consumer. The nature of military business and the consquences for failure dictates that the military cannot transition entirely to a just-in-time supply system. Commercial industry's just-in-time (JIT) supply management technique, which is the intellectual underpinning of the Army's distribution-based supply system, has proven not to be the panacea it was promised to be in the late 1980s and early 1990s. JIT did not eliminate supply inventory. JIT merely moved the inventory from the manufacturer to the supplier leaving manufacturers with no emergency spares while running their factories. Manufacturers had to have faith not only in the suppliers' delivery schedule but also in the quality of items delivered. When supply lines were international, risks grew in direct proportion to the distance.[5] The bright promise of savings and a streamlined supply chain has faded to bitter memories of hidden costs and scary shortages for some material managers.[6]

The existence of fixed facilities in a distribution system, particularly storage sites or depots, may appear to be unnecessary or uneconomical method of satisfying military logistical requirements in this era of near real time asset visibility. It would appear that the most economical method of distribution would be direct from the producer to the consumer: this would eliminate costs for additional handling and maintenance of fixed facilities as well as reducing inventory costs. This method is feasible in the distribution of items on which there is a predictable rate of demand and the item is consumed in large quantities by one customer or a group of customers in the same geographic region. Since it is highly improbable that DOD will be able to accurately predict the rate of demand for many categories of materiel in support of the military forces it becomes apparent that these fixed facilities are an essential element in physical distribution.[7] Aside from the strategic and tactical considerations there are good economic reasons. The large majority of items that move through the military distribution system are secondary items. Consumption by users is usually fairly erratic and unpredictable with individual demands made in small quantities. Also modern industrial production lines are not geared to economically satisfy small quantity demands of this type directly from the producer to the consumer. Startup and shutdown cost are high since production facilities are geared to large quantity production. Finally, acquisition overhead cost would be higher if procurements matched individual small quantity demands. If DOD and or the Army were forced to purchase materiel from industry to fill each requisition individually, our acquisition costs and the time it takes to provide the materiel would prevent timely and economic support to the user.[8]

There will still be inventories in the distribution-based supply system. There will be small temporary inventories of fast-moving supply lines and intransit materiel. The size of the inventories, however, will be dictated by the mission and not by mandated historical demands and their locations will reflect operational realities, priorities and available lift resources. The Army will still retain the option of shipping larger quantities and temporarily establishing supply activities to safeguard the supplies.[9]

One critical goal of the distribution-based supply system is the minimization of risk or the reduction of uncertainty, which plague all military supply operations. Uncertainty can be managed by increasing the flexibility of the supply system, making it respond to every possible contingency. Type I flexibility is flexibility useful in every possible contingency. In conditions of great uncertainty, when political and technological conditions are in flux, the pursuit of type I flexibility may be impossible or prohibitively expensive. Type II flexibility attempts to reduce the uncertainties confronting the decision-makers by buying information on competing development alternatives. This is the flexibility needed in the distribution-based supply system. It is premised on the assumption that some of the information resources can be used to reduce these uncertainties by developing a wide range of alternatives.[10]

The general principles here are two: work to reduce risk and uncertainty, and work to assure adaptability. Both of these depend heavily on leveraging information, at real-time or near-real-time information for logisticians to deliver precision logistics management. Improved processes must work better and faster in war as well as in peace. Large stocks were needed in the Cold War to help mitigate process risk. Improved logistics processes will be relied upon to deliver quickly the right support to the right places, avoiding massive stockpiling as a hedge. The resource reductions permitted by process improvement, particularly the reduction of stocks on hand, will require a significant change in organizational culture. It will be necessary to convince operational commanders that the improved processes do not place logistics support at risk. Demand uncertainty will always exist. VM and other process-improvement initiatives do not address that uncertainty directly; they work on reducing the uncertainty in the performance of the support processes.[11]

It would be useful to define clearly how the distribution-based supply system constitutes what is called the "Revolution in Military Logistics" (RML). This is difficult and there is an argument that states logistics is not undergoing a revolution at all, rather an impressive evolution. Exploiting information technology requires a revolution in mind-sets and behaviors, even if the revolution turns out to have been the cumulative result of many evolutionary steps along the way. But the most fundamental changes will be integrative developments driven by information technology. The very concept of dispersed but integrated forces and sensors, networked by distributed processing and operating at high speed, suggests unprecedented complexity in the distribution process. The observation that future operations are new and exceedingly complex, in both technological and operational terms, dictate that the supply system "revolutionize" its operation. The operations involve, for example, highly parallel and decisive operations with relatively small forces and accurate fires, precision engagement, rather than the deliberate concentration of forces practiced in the 20th century.[12] There may be no secure areas anywhere near the battlefield, and no clear-cut lines delineating friendly and or enemy zones, with dispersed forces relying on information to mass effects for precision engagement. RML should focus on assuring that the logistics are robust enough to support this diffuse battlefield.

When a system does not have visibility of what it contains, efficient management is not possible. Thus, information or asset visibility is a key to efficient distribution. Knowing what is in the system and where it is allows operators to make timely and effective decisions using the power of information. The cost of storing and retrieving information has declined even more rapidly than the cost of transportation. Computing costs have fallen exponentially. A bit-per-second cost of $1,000 in 1950 dropped to $1 in 1960 and $.001 in 1990, and the ability to move information rapidly has increased exponentially. DOD distribution processes were designed long before such capabilities were widely available. When it is possible to track a specific engine literally minute-by-minute through the repair and return process, it may be possible to have far fewer of them in the inventory.[13]

The cost of transportation has been decreasing significantly. Shipping costs for all modes have dropped sharply. Twenty-five years ago, it cost more than twice as much to ship material by sea or truck as it does today. Air and rail shipment costs are also sharply lower.[14] DOD distribution process must take into account the dramatic cost declines in transportation. For example, certain elements of the distribution process seek to minimize transportation costs by delaying shipments to allow consolidation or by using slower but cheaper transportation. Saving transportation costs is a worthy goal and probably made good sense in an era when transportation costs were high relative to the cost of the materiel being transported, but it may not make sense today. Delaying the shipment of expensive components causes the system to stock more of them. Given the high cost of some components, the cost-effective decision may be to pay the transportation premium and move them rapidly while simultaneously reducing customer wait time.

The DOD officials, faced with what some regard as a cumbersome, obsolescent, and expensive infrastructure, hope that similar streamlining efforts in the DOD infrastructure can yield substantial savings, which could then be used to pay for other things, particularly modernization.[15] DOD and or the Army must reduce unnecessary logistics infrastructure creating a lean, streamlined system. There is no question that there are areas where private sector logistics support can be substituted for DOD organic capabilities with greater effectiveness, at less cost, and with no added risk. It is equally important to avoid privatization for the sake of privatization and absolutely essential to strike the proper balance between efficiency, effectiveness, and risk. It is also worthwhile to remember those skills and capabilities lost to privatization will be difficult if not impossible to recover quickly if required.

Streamlined logistics processes not only reduce logistics infrastructure, they are more responsive and efficient, reducing the resources required providing a given level of support. Improving the repair-cycle time, from when a piece of equipment breaks until it is repaired and made available to the user, for example, can lower the requirement for expensive resources, such as the spare parts kept on hand. Process improvement typically involves a three-step approach: defining the process, measuring it, then improving the process. Once an improved process has been implemented, the approach is applied to another process, so that striving for improvement is continuous. To improve cycle times for such key logistics processes as order and ship, repair, and stockage determination, some of the military services have implemented promising programs. These include the Army's Velocity Management initiative, the Marine Corps' Precision Logistics, and the Air Force's Lean Logistics.[16]

The distribution-based supply system's faster cycle times enable inventories to be reduced without increasing risk, and these inventory reductions produce one-time savings. Personnel reductions may be possible, but in many cases, these have already been assumed in future budgets. Also, some of these savings would be achieved by reducing the military personnel the services fight to retain. When positions move from infrastructure to other areas, the total bill to DOD remains the same. Garnering savings in facilities operations takes a major effort such as a Base Realignment and Closure (BRAC). In short, savings from reengineering logistics, while promising, could be limited.[17]

Minimization of the logistics footprint in the theater of operations is a byproduct of the distribution-based supply system. An adequate logistics footprint is one of the key tenets of the RML.[18] There are a number of ways to reduce logistics structure in a theater of operations. First is to eliminate a function or process that the logisticians perform. Eliminating the function or process also eliminates the personnel required to perform it. Another method to reduce logistics infrastructure is to remove that function from the theater. The process or function is still important to the warfighter but it does not have to be performed in theater thereby removing those logistical personnel from the theater. It is important to note the difference between choices one and two. In choice two the process or function is still required just not in theater. In choice one the function is not required at all. Choice one eliminates logisticians from the force structure where choice two shifts the logisticians geographically performing split-based operations. Choice two can also shift the logisticians from the active to the reserve component where sixty-five percent of the combat service support capability resides.

Recommendations

There must be a single architect or organization tasked to develop, decompose challenges, establish study efforts, and integrate results of the distribution-based supply system. The architect would be involved in the design of the system, not just in its administration. This architect will act as the honest broker on competing concepts, assessing the experimentation results, and make decisions that will affect the composition of the distribution-based supply system. Research and development centers (RDCs) academic institutions, as well as commercial contractors should assist the lead organization technically. The responsible authority would be concerned not just with coordinating distribution activities and creating timelines but with architecture, research, analysis, and experimentation. This single focal point will coordinate change activity across the Army and avoid the grave danger of "dying the death of a thousand initiatives." This approach will execute a supply chain transformation plan that can move multiple, complex operating entities, both internal and external, in the same direction. The architect will ultimately be responsible for forcing the transition from experiments into controversial and painful changes of force structure. The supply system transformation strategy needs explicit pathways from experimentation to implementation.

Research is also needed on advanced methods for modeling and simulation of the distribution-based supply system. Computer models will mathematically represent the flow of materiel throughout the distribution-based supply system. These models will be used to recreate existing networks or determine the best combination and placement of intermediate facilities for a new network design. The experiments will prove useless unless enough time is set aside for participants to learn and assimilate the doctrinal concepts being tested. There must be considerable technical support as the tests are designed and conducted, which should be seen not as "demonstrations," but rather as research experiments to gain knowledge essential to decisions that will determine the future of the supply system. The investment in the scientific and analytical capacity to understand and model the complexity that will attend the new operations is imperative. The creation of an independent mechanism to measure progress and assist the process of moving the most promising ideas from the status of mere "experiments" to prototypes in the field will reduce the long lead time associated with systems development.

Decisions to privatize or outsource logistics functions must be examined very closely. Commercial experience with outsourcing has demonstrated both risks and rewards. The potential rewards include lower costs, better performance, an enhanced focus on what the organization does best, and more-rapid access to innovations. However, the risks can be considerable. Recovery time in replacing a source of goods or services can be so significant that it affects operational capability. The loss of real-time control, inadequate investment in specific assets, and the loss of critical skills are also risks. It may be difficult to recover skills that have been outsourced if the decision is made to return to a function.[19]

Numerous analyses examining Army materiel distribution in DOD have concluded that the process would benefit from applying modern industrial practices. The DOD should study industry distribution models carefully and selectively use or adapt them. Industry faces different challenges, but in many ways its volume and problems compare with those of DOD. Individual companies process greater volume than the

DOD does. During the height of the Persian Gulf War, DOD was processing 35,000 requisitions a day for the theater. The daily average for DOD in 1991 was 65,000. On an average day, United Parcel Service ships 11.5 million packages, and Federal Express moves 1.5 million. Of course, a single military requisition could represent many packages, but in terms of tracking items in a system, the two are comparable.[20]

Furthermore, the Army and or DOD should use a combination of their own system and commercial shipping companies to achieve highly responsive performance. This combination with dedicated trucks could lead to routine overnight delivery in the United States.

The Army supply system needs an organizational change that includes customer focus. By focusing on a single goal like industry, a satisfied customer, will establish credibility in the supply system. Commercial distribution operations may have subsidiary measures of merit, but they focus primarily on customer satisfaction. Focusing on the single goal of customer satisfaction, that agency can modify or eliminate anything in the system that does not contribute to that goal. Technological innovations apply systematically rather than functionally. The distribution system operates as exactly that; a system focused on a single goal. The result will be a simple, integrated, and focused operation. This process would require rigorous review to ensure that all subordinate elements and procedures are working toward achieving that goal. Technology can assist with many of the problems, but the system must be reengineered first to determine which steps can be eliminated, automated, or combined; which technologies are needed; and which of those offer the largest gain.

Commercial organizations have improved their distribution processes through a combination of organizational and technological change. Logistical reorganizations must occur to take fullest advantage of technological innovation. Improvements in either area alone will yield marginal benefits but in concert major gains can be expected. Technological innovation, in conjunction with organizational changes, will allow the distribution-based supply system to derive the maximum benefit from the technology.

The Army should establish reasonably high standards of performance for each distribution element and measure the performance of each element against the standard, not against averages. The RML should measure the balance between process efficiency and operational effectiveness.[21] All failures to meet the standards must be pursued until the reasons for the failures are identified and eliminated. The changes suggested are fundamental, systemic, and revolutionary and will not be easy to implement. The greatest challenge may be integrating the commercial approach into the theater of operations. However, unless these changes are made, the United States may find itself unable to pursue its interests wherever it needs to because it cannot provide its forces the logistical support they need. The Army must know what to change, what to change to, and how to cause the change. Given unlimited resources, almost any system could provide effective support, no matter how inefficient; but no system can provide effective support with insufficient resources.

Recommendations for Further Study

A topic for further study is the Army's distribution-based supply system integration with the other services in a joint environment. *Joint Vision 2010* states that Services and defense agencies will work jointly and integrate with the civilian sector.

The services will provide modular and specifically tailored combat service support packages in response to contingency operations.[22] It is implied that focused logistics will use a smaller more capable force to provide logistical support and the most efficient means of providing that support is through the combination of all of the services combat service support efforts operating in a truly seamless DOD logistical system.

A second consideration for further study deals with the force structure of the distribution-based supply system. Sixty-five percent of the combat service support force structure is in the reserve component and a major change to the supply system must include those forces to be viable and effective. The interoperability of the distribution-based supply system and the force structure of active component and reserve component (AC/RC) integrated forces should be explored to determine the effect on the total force concept.

A third consideration for further study is the examination of the myriad of mathematical models and computer simulations which represent the flow of materiel through a supply network. Commercial studies have shown that optimizing network designs have resulted in dollar savings and network optimization models could aid in Army distribution network design.

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